Cayton Valley Basin

General Basin Parameters

Acreage, Physiography

The Cayton Valley groundwater basin is located in Shasta County and is 1,300 acres (2 mi^2) in size. It is a northeast trending basin located west of Fall River Valley and north of Lake Britton. The basin is bounded to the east by several northwest trending faults and Pliocene andesitic rocks of Soldier and Fort Mountains. The basin is bounded to the north and west by Miocene basalt and to the south by Quaternary pyroclastic rocks

DWR estimates groundwater extraction for municipal and industrial uses to be 1 acre-foot per year. These estimates are based on surveys conducted by the DWR during 1995.

Major Sources of Recharge

Recharge to the basin is from precipitation, irrigation infiltration, and stream infiltration. The average annual precipitation in the basin ranges from 35 to 41 inches, increasing toward the northwest. Deep percolation of applied water is estimated by DWR (2004) to be 210 acre-feet. Cayton Creek, which traverses the basin, is a tributary to the Pit River.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1995. The Cayton basin is overlain with 73% agricultural land uses, 69% of which is rangeland (pasture). Table 4-47 provides details of the land uses within the basin.

Table 4-47. Land Use in the Cayton Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Pasture	907	69.40
Semiagricultural and Incidental	8	0.58
Idle	45	3.45
Subtotal	959	73.42
Native		
Native Vegetation	347	26.52
Water	1	0.06
Subtotal	347	26.58
Total	**1,307**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Shasta County adopted a groundwater ordinance in 1998. This ordinance requires a permit for groundwater exportation from the county. There are no water agencies in the basin. This basin falls with the area included in the Pit River Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify site-specific groundwater quality data in this basin. From DWR Bulletin 118 there do not appear to be any agriculturally-induced groundwater-quality problems in this groundwater basin.

Chrome Town Area Basin

General Basin Parameters

Acreage, Physiography

The Chrome Town Area Groundwater Basin is a north-south trending basin located near the eastern margin of the Coast Range consisting of Quaternary stream terrace deposits. The basin is bounded to the east by the Jurassic Knoxville Formation and lower Cretaceous marine sedimentary deposits. The basin is bounded on all other sides by the Jurassic Knoxville Formation (Jennings 1969). The basin is located in Glenn County and is 1,410 acres (2 mi^2) in size.

DWR (2004) estimated groundwater extraction and percolation of applied water based on a 1993 survey. Groundwater extraction for municipal and industrial uses is estimated to be 5 acre-feet. Deep percolation of applied water is estimated to be 200 acre-feet.

Major Sources of Recharge

Recharge to the basin is from infiltration of precipitation, infiltration of irrigation water and stream infiltration.

Annual precipitation is approximately 21 inches. Deep percolation of applied water is estimated to be 3 acre-feet. Chrome Creek drains the area in the north while Chrome creek, a tributary to Stony Creek, drains the area in the south.

Land Use

Land use surveys were conducted within the basin by DWR in 1998. Agricultural land use accounts for about 2% of the basin and native land use accounts for about 98% of the basin. Table 4-48 provides details of the land uses within the Chrome Town Area basin.

Table 4-48. Land Use in the Chrome Town Area Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Semiagricultural and Incidental	30	2.13
Subtotal	30	2.13
Native		
Native Vegetation	1,380	97.87
Subtotal	1,380	97.87
Total	**1,410**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Glenn County enacted a groundwater ordinance in 1990 and revised it in 2000. The key issues in the ordinance are the establishment of a Water Advisory Committee and Technical Advisory Committee, the establishment of basin management objectives, the establishment of a monitoring network and a requirement of permits for the exportation of groundwater outside the County. There are no cities and no water agencies in the Chrome Town Area Basin. This basin falls with the area included in the Colusa Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Clear Lake Cache Formation Basin

General Basin Parameters

Acreage, Physiography

The Clear Lake Cache Formation Groundwater Basin is 47 mi^2 in size and is located in Lake County. The following description of the hydrogeology for the basin is taken from DWR Bulletin 118 (2004).

The Clear Lake Cache Formation Groundwater Basin is located east of Clear Lake and shares a basin boundary with the Burns Valley Groundwater Basin to the southwest. The basin is bounded to the south by lower Cretaceous marine and Knoxville Formation deposits and Mesozoic ultra-basic intrusive rocks. The basin is bounded on the east by lower Cretaceous marine deposits and to the north and west by rocks of the Franciscan Formation. The basin is drained by the North Fork Cache Creek and by Cache Creek. Faulting is observed along portions of the western and southern boundaries.

The primary water-bearing formation is the Cache Formation. The Cache Formation is largely made up of lake deposits. The formation consists of tuffaceous and diatomaceous sands and silts, limestone, gravel, and intercalated volcanic rocks. In some areas the general lithology includes up to 400 feet of blue clay and shale with alternating strata of shale and limestone below 400 feet. The permeability of the formation is generally low.

According to DWR (2004), there is no hydrogeologic information available concerning groundwater level trends and storage.

Well completion reports in the basin showed a yield range for 12 municipal/irrigation wells from 11 to 245 gal/min, with an average of 52 gal/min. The average total depth of domestic wells (113 wells reported) is 103 feet, with a range from 23 to 450 feet. The average total depth of municipal/irrigation wells (23 wells reported) is 162 feet, with a range from 58 to 380 feet (DWR 2004).

Major Sources of Recharge

Precipitation is the primary source of recharge and ranges from 25 to 29 inches.

Land Use

Based on a 1995 DWR survey of land use and sources of water, the estimate of groundwater extraction for municipal/industrial use is 55 acre-feet. Deep percolation from applied water is estimated to be 61 acre-feet.

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for less than 1% of the basin, urban land use accounts for about 6% of the basin, and native land use accounts for about 93% of the basin. Table 4-49 provides details on the distribution of land use throughout the Clear Lake Cache Formation Basin.

Table 4-49. Land Use in the Clear Lake Cache Formation Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	5	0.02
Idle	16	0.05
Semiagricultural and Incidental	8	0.03
Vineyards	154	0.52
Subtotal	182	0.61
Urban		
Commercial	71	0.24
Industrial	85	0.28
Urban Residential	1,715	5.77
Vacant	39	0.13
Subtotal	1,910	6.42
Native		
Native Vegetation	27,534	92.58
Water	114	0.38
Subtotal	27,648	92.96
Total	**29,740**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County adopted a groundwater management ordinance in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). County of Lake is the sole public water agency in the basin. There are no private agencies reported. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

Groundwater sampling performed under the requirements of the DHS Title 22 program from 1994 through 2000 tested for primary and secondary inorganics, radiologicals, nitrates, pesticides, VOCs, and SVOCs. All three of the wells sampled for secondary inorganics showed concentrations above the MCLs for those constituents. Concentrations above the MCL for the other constituents were not detected (DWR 2004).

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

Lake County adopted a groundwater management ordinance in 1999 (DWR 2004). The DHS and its cooperators monitor 4 wells in the Clear Lake Cache Formation Basin for Title 22 water quality parameters.

Assessment of Data Adequacy and Need for Added Data

There is minimal agricultural land in the basin and no apparent impacts on groundwater quality.

Clover Valley Basin

General Basin Parameters

Acreage, Physiography

The Clover Valley Groundwater Basin is an irregular shaped basin that includes McReynolds Valley, Squaw Valley, Clover Valley, and Wakeynolds Valley. The valleys consist of deposits of alluvium and lake sediments. The basin is bounded by Miocene volcanic rocks on the north, east, and south and by Recent volcanic and Mesozoic granitic rocks to the west. Dixie Creek and Red Clover Creek drain the southern two-thirds of the basin to the west and Squaw Queen Creek drains the northern third of the basin to the northeast. The basin is 16,780 acres (26 mi^2) in size and is located in Plumas County. Dixie Creek and Red Clover Creek drain the southern two-thirds of the basin to the west and Squaw Queen Creek drains the northern third of the basin to the northeast.

Major Sources of Recharge

Recharge to the basin is from infiltration of precipitation. Annual precipitation ranges from 19 to 27 inches, increasing to the south.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. Clover Valley is contains only native land (Table 4-50).

Table 4-50. Land Use in the Clover Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Native		
Native Vegetation	10,440	62.20
Riparian	6,340	37.80
Total	**16,780**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

No known groundwater management plans, groundwater ordinances or basin adjudications. No known water agencies. No urban areas. This basin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Collayomi Valley Groundwater Basin

General Basin Parameters

Acreage, Physiography

The Collayomi Valley Basin aquifer system is 10 mi^2 in size and is located in Lake County. The following description of the hydrogeology in the Collayomi Valley Basin is taken from DWR Bulletin 118 (2004).

The Collayomi Basin includes both Collayomi Valley and Long Valley in the headwater area of Putah Creek. The two northwest-southeast trending valleys are considered a single groundwater basin due to their hydrologic continuity. The basin is bounded to the south by Jurassic-Cretaceous Franciscan, Knoxville, and volcanic rocks; to the west by undifferentiated Cretaceous rocks and Jurassic volcanic rock; to the north and northeast by Plio-Pleistocene Olivine basalt; and to the east by Jurassic volcanics. The basin is underlain by non-water-bearing sedimentary rocks of Jurassic-Cretaceous Franciscan and Knoxville formations that are capped locally by volcanic rocks. The basin boundary coincides with the edge of the valley floor except where water-bearing landslide debris and Quaternary basalt extend from beneath the valley floor into the uplands.

Nearly all groundwater throughout the Collayomi Basin occurs in Quaternary alluvium deposited as alluvial fans of shallow grade and in the gravel channels of Putah Creek, St. Helena Creek, and their tributaries. Groundwater occurs in a series of confined, semi-confined, and unconfined layers and lenses of permeable or semi-impermeable materials that are partially merged and interconnected. There is no evidence of any well-defined aquifer of any great areal extent within the basin. Pleistocene volcanics may also be a source of groundwater in the basin; however, no information is available on storage capacities and well yields within these units.

Quaternary alluvium in Collayomi Valley and Long Valley consists primarily of fine-grained deposits of clay and silt. However, alluvium in Collayomi Valley contains some coarse gravel channels and is more conducive to groundwater development in the basin. Along the channels of Putah and St. Helena Creeks, visible shallow deposits consist of fine sand to coarse cobbles and boulders with clean coarse gravel being dominant. In Long Valley, wells within the alluvial plain consist primarily of fine-grain material with low yields. A well log for Long Valley indicates that the alluvial fill is almost entirely clay from a depth of 64 to 230 feet. The maximum depths of alluvial fill in Collayomi and Long Valleys are approximately 350 feet and 475 feet respectively.

Storage capacity in the basin is estimated to be approximately 29,000 acre-feet. This is based on the assumptions that alluvium is 100 feet deep over an area of 4,000 acres with specific yield values of 6.5 and 4.5% for Collayomi and Long valleys respectively. Useable storage capacity is estimated at 7,000 acre-feet (DWR 2004). Maximum well yield is 1,200 gal/min, with an average yield of 500 gal/min (DWR 1975).

Major Sources of Recharge

The major source of recharge to the Collayomi Basin is from percolation of streamflow in Putah Creek, Dry Creek, and St. Helena Creek, although some recharge is derived from irrigation return flows and infiltration of rainfall. Annual precipitation in the basin ranges from 41 to 47 inches, decreasing to the northeast. Only minor quantities of surface streamflow are available for recharge in the Long Valley portion of the basin; however, streamflow may be impeded by hardpan conditions near the ground surface (DWR 2004).

Land Use

Estimates of groundwater extraction are based on a survey conducted by the DWR in 1995. The survey included land use and sources of water. Estimates of groundwater extraction for agricultural and municipal/industrial uses are 1,000 and 94 acre-feet respectively. Deep percolation from applied water is estimated to be 250 acre-feet (DWR 2004).

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for about 13% of the basin, urban land use accounts for about 9% of the basin, and native land accounts for about 78% of the basin. Table 4-51 provides details on the distribution of land use throughout the Collayomi Valley Basin.

Table 4-51. Land Use in the Collayomi Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	95	1.47
Grain and Hay	190	2.92
Idle	118	1.82
Pasture	88	1.35
Semiagricultural and Incidental	74	1.14
Vineyards	292	4.49
Subtotal	857	13.18
Urban		
Urban—uncliassified	54	0.83
Commercial	26	0.40
Industrial	93	1.43
Urban Landscape	14	0.21
Urban Residential	395	6.07
Vacant	10	0.16
Subtotal	592	9.10
Native		
Native Vegetation	5,032	77.39
Water	21	0.33
Subtotal	5,053	77.72
Total	**6,502**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County has adopted a groundwater management ordinance in 1999 for the Collayomi Valley Basin. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). The public water agencies within the basin include Hidden Valley Lake CSD and Middletown County Water District. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

Groundwater in the basin is characterized as magnesium bicarbonate type waters. TDS range from 150 to 255 mg/L, averaging 202 mg/L. Groundwater impairments include locally high iron and manganese. Locally high boron may be an issue for agricultural uses (DWR 2004).

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

Groundwater levels in the Collayomi Valley Basin are monitored semi-annually by DWR at 1 well and by Lake County at10 wells. DWR monitors for miscellaneous water quality parameters at 4 wells biennially and the DHS and its cooperators monitor for Title 22 water quality parameters at 3 wells.

According to the Sacramento River Watershed Evaluation Report (Sac Coalition 2004), agricultural producers in Lake County integrate BMPs including engineered drainage systems, cover crops, soil erosion prevention programs and buffer zones. Chemical Application Methods are almost exclusively ground sprayer or chemigation. Virtually all producers use PCAs that monitor orchard and vineyard pest populations and make formal written recommendations to control damaging pests. All PCAs are registered with the State of California.

Assessment of Data Adequacy and Need for Added Data

We could not find specific data for groundwater quality related to irrigated agriculture.

Coyote Valley Basin

General Basin Parameters

Acreage, Physiography

The Coyote Valley Basin is 10 mi^2 in size and is located in Lake County. The following description of the physiography and hydrogeology in the basin is taken from DWR Bulletin 118 (2004).

Coyote Valley is a northwest-southeast trending valley located within the southeastern portion of Lake County along Putah Creek about 4 miles northeast of Middletown. The valley is approximately 5 miles long and a maximum of 2.5 miles in width. The alluvial plain of the valley is bounded by sediments of the Jurassic-Cretaceous Franciscan-Knoxville groups and undifferentiated Cretaceous rocks on the west and northwest. The south and southeastern part of the valley is nearly isolated by low hills of basalt of Upper Jurassic age. The Plio-Pleistocene Cache Formation outcrops along the northern edge of the valley and

Plio-Pleistocene basalt outcrops are observed at the northeastern valley edge. The aquifer system of Coyote Valley Basin is primarily comprised of Quaternary Holocene alluvial deposits and, to a much lesser extent, Plio-Pleistocene Cache Formation deposits.

Holocene alluvium within the valley overlies the Cache Formation and is the primary water-bearing unit in the basin. The alluvium is made up of floodplain and channel deposits of Putah Creek and gently sloping alluvial fan deposits in the southwestern lobe of the valley and at the valley margins. The deposits consist of poorly stratified sand, gravel, and fine-grained material. The most productive strata are gravels that occur in sheets and stringers between beds of silty and sandy clay. The alluvial fill may range in thickness from 100 to 300 feet.

Volcanic rocks and underlying tuffaceous deposits (Upper Cache Formation) exist along the north edge and in the southeastern part of the valley and may be waterbearing. The tuffaceous deposits are poorly consolidated and apparently lie at considerable depth beneath the hills to the northeast, where they are overlain by, and possibly interbedded with, basaltic flows. The lithology of the sediments associated with lava flows along the north edge of Coyote Valley is like that of the Upper Cache near Clear Lake, except for the composition of the cobble gravels, which are composed largely of rounded cobbles of white rhyolite. The Cache Formation outcrops on the northeast edge of Coyote Valley and probably underlies much of the Holocene alluvium. It is composed of gravel, silt, and sand, and near the top of the section, water–laid tuffs and tuffaceous sands become dominant. The permeability in the Cache formation is variable, but generally low. Most of the strata are too high in clay or silt for water movement to be great. Groundwater flow through a few coarse sedimentary strata and volcanic deposits may be appreciable.

Storage capacity of the basin is estimated to be 27,000 acre-feet. This estimate is based on the areal extent of alluvium within the basin (approximately 3,000 acres) for a saturated depth interval of 10 to 100 feet, having a specific yield of 10%. Another estimate of storage capacity is 29,000 acre-feet with a useable storage capacity of 7,000 acre-feet.

Major Sources of Recharge

The major source of groundwater recharge is from Putah Creek. Lesser amounts of recharge occur from precipitation upon the alluvial plain and from side-stream runoff. Annual precipitation in the valley ranges from 37 to 41 inches, increasing to the north (DWR 2004).

Land Use

Estimates of groundwater extraction for agricultural and municipal/industrial uses are 1,400 and 290 acre-feet respectively, based on a 1995 groundwater extraction survey conducted by the DWR. Deep percolation from applied water is estimated to be 1,100 acre-feet.

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for about 34% of the basin, urban land use accounts for about 14% of the basin, and native land accounts for about 52% of the basin. Table 4-52 provides details on the distribution of land use throughout the Coyote Valley Basin.

Table 4-52. Land Use in the Coyote Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	54	0.82
Grain and Hay	192	2.93
Idle	349	5.35
Pasture	1,039	15.90
Semiagricultural and Incidental	46	0.70
Vineyards	524	8.02
Subtotal	2,203	33.72
Urban		
Urban—unclassified	20	0.31
Commercial	48	0.74
Industrial	45	0.69
Urban Landscape	117	1.79
Urban Residential	691	10.58
Vacant	8	0.12
Subtotal	929	14.22
Native		
Native Vegetation	3,181	48.69
Water	220	3.36
Subtotal	3,401	52.06
Total	**6,533**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County adopted a groundwater management ordinance for the basin in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). There are no private or public water agencies listed. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

Groundwater in the basin consists of magnesium bicarbonate type waters. TDS ranges from 175 to 390 mg/L, averaging 288 mg/L. Water quality impairments include locally high magnesium (DWR 2004).

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information.

Management Practices

Groundwater levels in the Coyote Valley Basin are monitored semi-annually at one well by DWR 1 well, and at 6 wells by Lake County. Miscellaneous water quality parameters are measured by DWR on a biennial basis at 3 wells, while DHS and its cooperators monitor for Title 22 water quality parameters at 3 wells.

According to the Sacramento River Watershed Evaluation Report (Sac Coalition 2004), agricultural producers in Lake County integrate BMPs including engineered drainage systems, cover crops, soil erosion prevention programs and buffer zones. Chemical Application Methods are almost exclusively ground sprayer or chemigation. Virtually all producers use PCAs that monitor orchard and vineyard pest populations and make formal written recommendations to control damaging pests. All PCAs are registered with the State of California.

Assessment of Data Adequacy and Need for Added Data

We did not find data for groundwater quality related to irrigated agriculture in the Coyote Valley Subbasin.

Dixie Valley Basin

General Basin Parameters

Acreage, Physiography

The Dixie Valley Groundwater Basin is an elongated east/west trending alluvial basin located south of Bald Mountain and west of Madeline Plains in western Lassen County. The basin is bounded to the south by Pleistocene basalt and on all other sides by Pliocene basalt (Lydon 1960). Indian Creek flows into the valley from the east. The valley is drained by Horse Creek, which flows northwest to the Pit River. The basin is 4,870 acres (8 mi^2) in size and is located in northeastern Lassen County.

There is no information about the hydrogeology of Dixie basin available.

DWR estimated the groundwater extraction for the Dixie Valley Basin from a 1997 survey. The survey included land use and sources of water. Groundwater extraction for municipal and industrial uses was estimated to be 2 acre-feet annually. Deep percolation of applied water was estimated to be 420 acre-feet annually.

Major Sources of Recharge

Recharge to the basin is from precipitation, irrigation infiltration and stream infiltration.

Annual precipitation in the valley ranges from 17 to 19 inches, increasing to the north. Deep percolation of applied water was estimated to be 420 acre-feet by DWR in 1997. Indian Creek flows into the valley from the east. The valley is drained by Horse Creek, which flows northwest to the Pit River.

Land Uses

Land use surveys were conducted within the basin by DWR in 1997. Agricultural land use accounts for about 54% of the basin and native land use accounts for about 46% of the basin. There is no urban land in the Dixie Valley basin. Table 4-53 provides details of the land uses within the basin.

Table 4-53. Land Use in the Dixie Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Pasture	2,470	50.70
Semiagricultural and Incidental	10	0.20
Idle	140	2.90
Subtotal	2,620	53.80
Native		
Native Vegetation	2,180	44.80
Water	70	1.40
Subtotal	2,250	46.20
Total	**4,870**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lassen County enacted a groundwater ordinance in 1999 that requires a permit for groundwater exported from the county. No known groundwater management plans or basin adjudications. This basin falls with the area included in the Pit River Coalition.

Water Quality

There is no water quality data available for this basin.

Discharge Pathways and Sources of Contaminants

No information available.

Management Practices

No information available.

Assessment of Data Adequacy and Need for Added Data

There is very little information available regarding this groundwater basin.

Dry Burney Creek Basin

General Basin Parameters

Acreage, Physiography

The Dry Burney Creek Valley Groundwater Basin is bounded to the northwest, west, and south by Pliocene andesite of Don Hurt Mountain, Stacher Butte, and Jacks Backbone. The basin is bounded to the east by Pleistocene basalt of Whittington Butte and Horse Heaven Buttes (Lydon 1960). The basin is 3,070 acres (5 mi^2) in size and is located in eastern Shasta County.

The water-bearing formation in the basin is the Quaternary alluvium.

Major Sources of Recharge

Recharge to the aquifer is mostly by infiltration precipitation into the alluvium. Annual precipitation ranges from 49 to 55 inches, increasing to the southeast.

Land Uses

Land use surveys were conducted within the basin by DWR in 1999. Dry Burney Creek Valley basin is 100% native vegetation (Table 4-54).

Table 4-54. Land Use in the Dry Burney Creek Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Native		
Native Vegetation	3,080	100.00
Total	**3,080**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Shasta County adopted a groundwater management ordinance in 1998. This ordinance requires a permit for groundwater exportation from the county. There are no water agencies involved with the management of Dry Burney Creek Valley basin. This basin falls with the area included in the Pit River Coalition.

Water Quality

Groundwater does not appear to be impaired in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to find information about pathways and sources of contaminants.

Management Practices

No available information.

Assessment of Data Adequacy and Need for Added Data

There is no water quality data available for Dry Burney Creek Valley basin. From the Shasta County General Plan and DWR Bulletin 118, there do not appear to be groundwater quality problems in this groundwater basin.

Egg Lake Valley Basin

General Basin Parameters

Acreage, Physiography

The Egg Lake Valley Basin is 6 mi^2 (4,100 acres) in size and is located in Modoc County. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004). The Egg Lake Valley Basin is bounded to the south by Tertiary volcanics of Egg Lake Butte, to the east by Recent basalt, and on all other sides by Miocene basalt. The basin consists of Quaternary lake deposits.

The single municipal/irrigation well completed in the basin is reported to have a yield of 20 gal/min and a total depth of 440 feet. A domestic well completed in the basin is reported to have a total depth of 300 feet. No information is available on the yield of the domestic well.

Major Sources of Recharge

Annual precipitation is the major source of recharge and ranges from 19 to 21 inches.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. The entire basin consists of native vegetation and water. Table 4-55 provides details on the distribution of land use throughout the Egg Lake Valley Basin.

Table 4-55. Land Use in the Egg Lake Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Native		
Native Vegetation	1,617	39.41
Water	2,485	60.59
Total	**4,102**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Modoc County adopted a groundwater management ordinance in 2000. A key element of the Modoc County ordinance is the requirement of an export permit for groundwater transferred out of the basin (DWR 2004). There are no public or private water agencies in the basin. This basin falls with the area included in the Pit River Coalition.

Water Quality

As required under the DHS Title 22 program, wells within the basin were sampled for the presence of primary and secondary inorganics, nitrates, pesticides, and VOCs and SVOCs. None of the wells sampled from 1994 through 2000 had a detection above the MCL (DWR 2004).

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Elk Creek Valley Basin

General Basin Parameters

Acreage, Physiography

The Elk Creek Groundwater Basin is located in east-central Glenn County and is 1,450 acres (2 mi^2) in size. Stony Creek borders the basin on the southeast while Elk Creek flows down the center of the Valley. Stony Creek and Elk Creek converge in the basin. Elk Creek, Briscoe Creek and Stony Creek drain the

Valley. There is no hydrogeologic information available for Elk Creek Valley basin.

Major Sources of Recharge

Recharge to the basin is from infiltration of precipitation, infiltration of irrigation water and stream infiltration. Six percent of the land use in the Valley is irrigated agriculture; however, the amount of infiltration of applied water has not been estimated.

Land Use

Land use surveys were conducted within the basin by DWR in 1998. Agricultural land use accounts for about 6% of the basin, urban land use makes up about 6% of the basin and native land accounts for about 88% of the basin area. Table 4-56 provides details of the land uses within the Elk Creek Valley basin.

Table 4-56. Land Use in the Elk Creek Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Citrus and Subtropical	60	4.14
Field Crops	30	2.07
Subtotal	90	6.21
Urban		
Urban	60	4.14
Commercial	10	0.69
Urban Landscape	10	0.69
Subtotal	80	5.52
Native		
Riparian	20	1.38
Native Vegetation	1,200	82.76
Water	60	4.14
Subtotal	1,280	88.28
Total	**1,450**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Glenn County enacted a groundwater ordinance in 1990 and revised it in 2000. The key issues in the ordinance are the establishment of a Water Advisory Committee and Technical Advisory Committee, the establishment of basin management objectives, the establishment of a monitoring network and a requirement of permits for the exportation of groundwater outside the County. There are no cities and no water agencies in the Elk Creek Basin. This basin falls with the area included in the Colusa Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Fairchild Swamp Area Basin

General Basin Parameters

Acreage, Physiography

The Fairchild Swamp Area groundwater basin is located in Modoc County and is 3,300 acres (5 mi^2) in size. It is a north trending basin following the north trending fault system in the region. The basin is bounded on all sides by Plio-Pleistocene basalt flows. The flows consist of gray to black ophitic to sub-ophitic basalt and basaltic andesite. The flows are highly fractured, nearly flat lying, and dip toward the south. Basin deposits consist of Quaternary alluvium. (DWR 2004.)

Major Sources of Recharge

Recharge to the Fairchild Swamp Area aquifer is by infiltration of precipitation into the alluvium, stream infiltration and subsurface flow. Average annual precipitation within the basin is estimated to be 17 to 19 inches.

Boles Creek

Land Use

Land use surveys were conducted within the basin by DWR in 1997.

Table 4-57. Land Use in the Fairchild Swamp Area Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Field Crops		
Grain and Hay		
Pasture		
Rice		
Semiagricultural and Incidental		
Truck, Nursery, and Berry Crops		
Idle		
Subtotal		
Urban		
Urban—unclassified		
Commercial		
Industrial		
Urban Landscape		
Urban Residential		
Vacant		
Subtotal		
Native		
Native Vegetation		
Water		
Riparian		
Subtotal		
Total		**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

This basin does not fall with any area included in a Coalition.

Water Quality

Discharge Pathways and Sources of Contaminants

Fall River is the primary stream draining the northern and central-valley areas, and the Pit River is the primary stream in the easterly and southerly portion of the basin. These rivers converge at the southwestern corner of the valley near Fall River Mills and flow westward out of the valley.

Management Practices

Assessment of Data Adequacy and Need for Added Data

There is no water quality data available for Fairchild Swamp Area basin, therefore it is unknown if there are any groundwater quality concerns.

Fall River Valley Basin

General Basin Parameters

Acreage, Physiography

The Fall River Valley groundwater basin is located in Lassen and Shasta Counties at 3,300 feet elevation. It is bounded on the east by Tertiary basalt of the Big Valley Mountains, and on the west by Pleistocene basalt and Pliocene andesite of Soldier and Saddle Mountains. Less distinct boundaries are to the north and south as low relief volcanic plateau areas of basalt. Fall River is the primary stream draining the northern and central-valley areas, and the Pit River is the primary stream in the easterly and southerly portion of the basin. These rivers converge at the southwestern corner of the valley near Fall River Mills and flow westward out of the valley.

The following description of the hydrogeology in the Fall River Valley basin is taken from DWR Bulletin 118 (DWR 2004).

The primary water-bearing formations are Holocene sedimentary deposits, Holocene lava flows, Pleistocene lake and near-shore deposits, and Pleistocene to Pliocene volcanic rocks.

Holocene sedimentary deposits include intermediate alluvium and alluvial fans. The intermediate alluvium consists of unconsolidated silt, sand, and gravel up to 100 feet thick. These deposits occur along stream channels and on the floodplain. The permeability of these materials is moderate to high. However, with the exception of some areas along Bear Creek and the Pit River, the alluvial deposits are too thin to be of importance for groundwater development.

The alluvial fans consist of unconsolidated, poorly stratified silt, sand, and gravel to a thickness of 200 feet. These deposits are limited to the eastern margin of the valley and are primarily recharge areas but may yield moderate quantities of groundwater in places. These deposits are moderately permeable and contain confined and unconfined zones.

The Holocene volcanic rocks originate from the Medicine Lake Highlands and consist of highly jointed, vesicular basalt flows, scoria, cinder cones and associated lenses of cinders ranging in thickness from 30 to 500 feet. These volcanic rocks are highly permeable. At the north end of the valley, where these deposits mantle the uplands, they serve as a major recharge area and feed numerous streams and springs.

Pleistocene near-shore deposits consist of partly consolidated clay, silt, and sand up to 300 feet thick. These deposits are moderately permeable and yield fair quantities of groundwater to wells.

Pleistocene volcanic rocks consist of partly consolidated, bedded cinders and highly jointed basalt flows ranging from 50 to 750 feet in thickness. The cinder beds are highly permeable but are of limited extent and are not significant valley wide. Overall, the basalt flows are moderately to highly permeable and can yield large amounts of confined water where interbedded with lake deposits. There is substantial variation in the water transmitting capabilities of these rocks. Some areas have basalt exposures that are essentially impermeable.

Pliocene volcanic rocks consist of basalt flows interbedded with pyroclastic rocks. Due to weathering and infilling of joints and fractures with fines, these rocks have low to moderate permeabilities and yield lesser amounts of groundwater to wells than the younger volcanic rocks.

Block faulting by northwestward-trending faults of late Pleistocene and possibly Holocene age is the dominant structural feature. There are at least three fault systems that control the complex displacement structure. The basin is a fault trough in which a downthrown group of blocks is situated between two groups of elevated blocks. The volcanic rocks that underlie the valley have also been tilted and broken into several smaller blocks. Faulting has probably created shattered permeable zones for groundwater movement in the volcanic rocks. Within the sedimentary deposits faulting may have created barriers to groundwater movement.

Water levels in the basin are variable and are commonly dependent on the topographic elevation of a particular area, proximity to the Pit River, and localized pumping effects. In general, the northern portion of the basin consistently has the shallowest depths to groundwater (10 feet or less). Areas adjacent to the Pit River display more variable conditions.

The groundwater storage capacity to a depth of 400 feet is estimated to be 1,000,000 acre-feet (DWR 1963). DWR (1963) notes that the quantity of water that is useable is unknown.

Groundwater extraction, as estimated by DWR, is 19,000 acre-feet for municipal uses and 240 acre-feet for industrial uses.

The 1984 DWR study of the Eastern Upland area of Shasta County showed potential groundwater limitations in the area north of State Highway 299 in the Eastern Upland planning area.

Major Sources of Recharge

Recharge to the Fall River Valley aquifer is mostly by subsurface flow and infiltration of precipitation into the alluvium. Average annual precipitation within the basin is estimated to be 17 to 27 inches in the valley and 29 to 43 inches in the upland areas to the west. DWR (2004) estimated recharge by deep percolation of applied water is estimated to be 4,800 acre-feet.

The alluvial fans on the eastern margin of the valley are aquifer recharge areas. They consist of unconsolidated, poorly stratified silt, sand, and gravel to a thickness of 200 feet.

In the GAMA study, Moran et al. (2005) show evidence that subsurface flow also recharges the Fall River Valley basin. Two wells in Fall River Mills, in the distal portion of the groundwater flow field, have mantle helium components that show the affect of volcanic activity to the north indicating inflow into the basin from these areas.

At the north end of the Fall River Valley deposits from Holocene volcanic rocks serve as a major recharge area and feed numerous streams and springs. These springs have sustained flows measured at 1,400 to 2,000 cubic feet per second and provide the bulk of the base flow that sustains most of the streams, ponds and lakes in the area. It has been speculated that the subsurface inflow for these springs originates 50 miles or more to the north at the Tule Lake/Klamath Lake basins and flows beneath and through the Medicine Lake Highlands. These springs have been extensively appropriated or diverted for irrigation and power development.

Land Use

Land use surveys were conducted within the basin by DWR in 1995. The foothills situated in the Eastern Upland region of Shasta County, which contains Fall River Valley basin contain a high percent of rangelands. The Fall River Valley basin is overlain with 57% agricultural land uses, 32% of which is rangeland. Table 4-58 provides details of the land uses within the basin.

Table 4-58. Land Use in the Fall River Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Field Crops	1,017	1.86
Grain and Hay	3,110	5.70
Pasture	17,422	31.94
Rice	1,321	2.42
Semiagricultural and Incidental	477	0.87
Truck, Nursery, and Berry Crops	822	1.51
Idle	6,679	12.24
Subtotal	30,847	56.55
Urban		
Urban—unclassified	417	0.76
Commercial	25	0.05
Industrial	79	0.15
Urban Landscape	9	0.02
Urban Residential	406	0.74
Vacant	79	0.15
Subtotal	1,015	1.86
Native		
Native Vegetation	17,421	31.94
Water	3,034	5.56
Riparian	2,233	4.09
Subtotal	22,689	41.59
Total	**54,551**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Although Shasta County has a groundwater ordinance, Fall River Valley itself, has no groundwater management plan. The largest extraction from the aquifer is for the paper mills and is 13 million gallons per day (mgd). There are also at least 470 wells (domestic and irrigation) drawing on the Fall River Valley aquifer (DWR 2004). The city of Fall River Mills relies solely on groundwater for its public water supply. Fall River Valley lies within the Pit River subwatershed. This basin falls with the area included in the Pit River Coalition.

Water Quality

The mineral quality of groundwater in the basin ranges varies primarily as a function of recharge water. Water from wells in the unconfined volcanic rocks within and adjacent to this basin is quite good with a calcium/magnesium bicarbonate character and low to moderate TDS. In the central portion of the basin, where lake deposits are thick, a sodium bicarbonate character is prevalent. In the western portion of the basin numerous wells produce groundwater with elevated iron concentrations. The concentration of TDS ranges from 115 to 232 mg/L, averaging 174 mg/L (DWR 2004).

There are high concentrations of nitrate, manganese, ammonia, and phosphorus in localized areas throughout the basin. Some well waters have high iron concentrations.

Discharge Pathways and Sources of Contaminants

Groundwater discharges to Fall River which is the primary stream draining the northern and central-valley areas, and the Pit River is the primary stream in the easterly and southerly portion of the basin. These rivers converge at the southwestern corner of the valley near Fall River Mills and flow westward out of the valley.

Management Practices

Pasture land comprised 32% of the land uses in Fall River Valley. Brush encroachment in rangelands can be controlled by removal of brush through controlled burns and/or mechanical and chemical treatment. Controlled burning in rangeland has been practiced in Eastern Shasta County for a number of years both to improve grazing lands and reduce fire hazards. Herbicide application has been used to control brush as well. We were unable to identify specific management practices related to groundwater quality.

Assessment of Data Adequacy and Need for Added Data

There is little water quality data available for Fall River Valley basin. Based on the Shasta County General Plan and DWR Bulletin 118 there does not appear to be widespread impairments in this groundwater basin. Localized nitrates, phosphorus, and ammonia may be the result of cattle manure and possibly fertilizer application.

Funks Creek Basin

General Basin Parameters

Acreage, Physiography

The Funks Creek Groundwater Basin is 5 mi^2 (3,000 acres) in size and is located in Glenn and Colusa Counties. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004).

The Funks Creek Groundwater Basin is located north of Antelope Valley and overlies the boundary of Glenn and Colusa Counties. The basin is north of a series of northeast trending faults and is bounded on all sides by Upper Cretaceous Marine deposits. The basin consists of Quaternary alluvial deposits and is drained to the east by Grapevine Creek and Funks Creek.

Hydrologic information was not available from DWR for the following: water-bearing formations, groundwater level trends, storage, groundwater budget, and groundwater quality.

Major Sources of Recharge

Annual precipitation is approximately 18 inches and is the primary source of recharge for the basin.

Land Use

Land use surveys were conducted within the basin by DWR in 1998. Agricultural land use accounts for about 17% of the basin, and native land use accounts for about 83% of the basin. Table 4-59 provides details on the distribution of land use throughout the Funks Creek Basin.

Table 4-59. Land Use in the Funks Creek Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Grain and Hay	511	16.96
Semiagricultural and Incidental	6	0.21
Subtotal	518	17.18
Native		
Native Vegetation	2,464	81.73
Water	33	1.09
Subtotal	2,496	82.82
Total	**3,014**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Glenn County adopted a groundwater management ordinance in 2000. Colusa County adopted a groundwater management ordinance in 1998. There are no public or private water agencies in the basin. This basin falls with the area included in the Colusa Coalition.

Water Quality

For the period of November 1, 1983 to June 30, 2003, the DPR reported 82 wells with verified pesticide detections and 27 wells with unverified pesticide detections in Glenn County. Funks Creek Basin is located within Glenn County. Three hundred and seventy-six wells were sampled for 117 pesticides (DPR 2003). The following compounds were detected and verified: atrazine (in 37 wells), bentazon (in 29 wells), DEA (in 4 wells), diuron (in 1 well), prometon (in 9 wells), and simazine (in 21 wells). We were unable to identify wells in the Funks Creek Basin that had pesticide detections.

Discharge Pathways and Sources of Contaminants

Grapevine and Funks Creeks are the primary discharge pathways for groundwater from this basin. We were unable to locate information on sources of contaminants.

Management Practices

We were unable to locate information about management practices related to groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable locate any specific data for this basin.

Goose Valley Basin

General Basin Parameters

Acreage, Physiography

The Goose Valley groundwater basin is bounded to the west, north, and east by Pliocene basalt and to the south by Pleistocene basalt. It is located in a region of northwest trending faults in the mountains of eastern Shasta County. The basin is 4,210 acres (7 mi^2) in size. The water-bearing formation in the basin consists of Quaternary lake deposits. Groundwater extraction for municipal and industrial uses is estimated by DWR (2004) to be 2 acre-feet.

Major Sources of Recharge

Recharge to the Goose Valley aquifer is mostly by infiltration precipitation into the alluvium. Annual precipitation ranges from 29–33 inches. DWR (2004) estimated recharge by deep percolation of applied water is estimated to be 1,100 acre-feet.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1999. The foothills situated in the Eastern Upland region of Shasta County, which contains Goose Valley basin are comprise of 54% of rangelands and 8% native land uses. This basin is sparsely populated. Table 4-60 provides details of the land uses within the subbasin.

Table 4-60. Land Use in the Goose Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Grain and Hay	422	10.01
Pasture	2,273	53.98
Rice	1,180	28.02
Semiagricultural and Incidental	11	0.25
Subtotal	3,885	92.27
Native		
Riparian	43	1.03
Native Vegetation	282	6.70
Subtotal	326	7.73
Total	**4,210**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Shasta County adopted a groundwater management ordinance in 1998. This ordinance requires a permit for groundwater exportation from the county. This basin falls with the area included in the Pit River Coalition.

Water Quality

There is no water quality data available for this basin.

Discharge Pathways and Sources of Contaminants

Groundwater is pumped for domestic and irrigation purposes. Groundwater discharges to local streams. No water quality data is available.

Management Practices

Brush encroachment in rangelands can be halted by removal of brush through control burns and/or mechanical and chemical treatment. Range improvement burning has been practiced in Eastern Shasta County for a number of years both to improve grazing lands and reduce fire hazards. Herbicide application has been used to control brush as well.

Assessment of Data Adequacy and Need for Added Data

There is no water quality data available for Goose Valley basin. From the Shasta County General Plan and DWR bulletin 118, there does not appear to be impairments in this groundwater basin.

Fandango Valley Subbasin—Goose Lake Valley Basin

General Basin Parameters

Acreage, Physiography

The Fandango Valley Groundwater subbasin is part of the Goose Lake Valley Groundwater Basin which is located in Modoc County and extends north into Lake County, Oregon. The valley is approximately 47 miles long and 12 miles wide. It lies at an elevation of about 4,700 feet. Two thirds of the Goose Lake Valley is in Oregon. The basin is a down-faulted block with numerous bounding faults on the west and east side of the valley. Goose Lake occupies 144 mi^2 of the southern portion of the basin. The Fandango Valley subbasin is 18,500 acres (27 mi^2) in size. It is located in Modoc County. The subbasin is an irregularly shaped groundwater basin that includes Fandango Valley and the area previously identified as the Willow Ranch subbasin (DWR 1963).

The following description of the hydrogeology in the Fandango Valley subbasin is taken from DWR Bulletin 118 (DWR 2004).

The primary water-bearing formations are Holocene sedimentary deposits (which include lake deposits, intermediate alluvium, and alluvial fan deposits) and Pleistocene near-shore deposits and lava flows. The following summary of water-bearing formations is from DWR (1963).

The lake deposits consist of unconsolidated interstratified clay and silty clay limited in extents to the Willow Ranch area. Water produced from these sediments may be of poor quality depending on the degree of alkalinity.

The intermediate alluvium consists of unconsolidated, poorly sorted silt and sand with lenses of gravel up to a thickness of 100 feet. The thickness of the deposits is considerably less for Fandango Valley. These zones are moderately permeable.

The alluvial fan deposits consist of unconsolidated to poorly consolidated, partially stratified sand, gravel, and silt with lenses of clay. These deposits are generally the most permeable of the valley sedimentary deposits. The eastside alluvial fans range up to 300 feet in thickness and are considered the most important groundwater source. The upper fan areas are moderately to highly permeable and, where saturated, can yield large amounts of water to wells. The mid- to lower fans are generally less permeable but contain confined zones yielding moderate amounts of water to wells. The alluvial fan deposits in Fandango Valley are considerably less in thickness due to their limited areal extent.

Near-shore deposits occur at the south end of the subbasin. The deposits are moderately to highly permeable and may yield large quantities of water to wells.

The Pleistocene volcanic rocks consist of highly jointed flat lying basalt flows ranging from 50 to 200 feet in thickness with interbedded scoriaceous zones and pyroclastic rocks. These rocks serve as a recharge zone and interfinger with valley sediments. In general these rocks are highly permeable and can yield large amounts of water to wells.

In Goose Valley Basin (including Lower Goose Valley and Fandange subbasins) groundwater storage to a depth of 500 feet is estimated to be 1,000,000 acre-feet (DWR 1963).

Major Sources of Recharge

The Fandango Valley subbasin is bound on the west by Goose Lake and on the west by the Warner Mountains. Goose Lake is an intermittent lake that gains water from the Fandango Valley groundwater subbasin. The water level fluctuates and the lake has been completely dry several times since the early 1900s (DWR 1963). All surface drainage in the Goose Lake Valley basin is to Goose Lake. Intermittent streams characterize the flanks of the Warner Mountains, where streams commonly are lost to infiltration of the permeable alluvial-fan deposits that they traverse after leaving the canyons. Willow, Lassen, Davis, and New Pine Creeks are the major streams of the Fandango basin. Most streams in the basin have their peak discharge in April or May, when they are fed by snowmelt.

The major sources of recharge to the Fandango Valley subbasin are infiltration of surface water and precipitation. Upland recharge areas consist of the permeable basalt flows of Pliocene to Pleistocene age. Precipitation and surface runoff infiltrates the basalt flows and percolates towards the valley, and along Willow Creek, recharging valley sediments. Most of the recharge to deeper aquifers along the east side of the California portion of Goose Lake Valley is derived from infiltration of surface water, generally along the foothill portions of stream channels. DWR estimates Annual precipitation ranges from 17 to 19 inches in the Willow Ranch area and from 19 to 23 inches in Fandango Valley.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1997. Agricultural land uses made up 27% of the basin, native vegetation made up 73% of the basin and only 0.19% of the basin was urban. Land use details are displayed in Table 4-61. The portion of Goose Valley that is in Oregon is heavily used for agricultural purposes and water is diverted from the tributary streams and pumped from groundwater in order to irrigate crops.

Table 4-61. Land Use in the Fandango Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	32	0.18
Grain and Hay	290	1.57
Pasture	4,445	24.12
Semiagriculture and Incidental	129	0.70
Subtotal	4,896	26.57
Urban		
Urban Residential	35	0.19
Subtotal	35	0.19
Native		
Native Vegetation	10,048	54.52
Water	1,644	8.92
Riparian	1,807	9.81
Subtotal	13,500	73.25
Total	**18,431**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Modoc County adopted a groundwater management ordinance in 2000. A key element of the ordinance requires an export permit for transfers of water out of the basin (DWR 2004). Small communities exist on Deer Creek and New Pine Creek. This subbasin falls with the area included in the Pit River Coalition.

Water Quality

Calcium bicarbonate type waters occur throughout the basin. Sodium bicarbonate waters are found below 200 feet in a three square mile area east of Goose Lake and south of New Pine Creek. The concentration of TDS averages 183 mg/L and ranges from 66 to 528 mg/L.

Discharge Pathways and Sources of Contaminants

Groundwater is extracted from the basin for municipal and agricultural purposes. Estimates of groundwater extraction for the Goose Lake Basin (including Lower Goose Lake Valley and Fandango subbasins) are based on a survey conducted by the DWR during 1997. Estimates of groundwater extraction for agricultural and municipal /industrial uses are 10,000, and 25 acre-feet respectively.

Management Practices

No known data.

Assessment of Data Adequacy and Need for Added Data

There is no water quality data available for Fandango subbasin, therefore it is unknown if there are any impairments.

Lower Goose Lake Valley Subbasin—Goose Lake Valley Basin

General Basin Parameters

Acreage, Physiography

The Lower Goose Lake Valley Groundwater subbasin is part of the Goose Lake Valley Groundwater Basin which is located in Modoc County and extends north into Lake County, Oregon. The valley is approximately 47 miles long and 12 miles wide. It lies at an elevation of about 4,700 feet. Two thirds of the Goose Lake Valley is in Oregon. The basin is a down-faulted block with numerous bounding faults on the west and east side of the valley. Goose Lake occupies 144 mi^2 of the southern portion of the basin. The Lower Goose Lake Valley subbasin is 36,000 acres (56 mi^2) in size. It is bounded on the north by Goose Lake, on the east by Pliocene and Tertiary basalt and Tertiary intrusive rocks of the Warner Mountains, and on the west by Pliocene basalt of the Modoc Plateau.

The following description of the hydrogeology in the Lower Goose Lake Valley subbasin is taken from DWR Bulletin 118 (DWR 2004).

The primary water-bearing formations are Holocene sedimentary deposits (which include lake deposits, intermediate alluvium, and alluvial fan deposits), Pleistocene near-shore deposits, Pliocene to Pleistocene lava flows, and to a lesser extent, the Plio-Pleistocene Alturas Formation. The following summary of water-bearing formations is from DWR (1963).

The lake deposits consist of unconsolidated interstratified clay and silty clay. Water produced from these sediments may be of poor quality depending on the degree of alkalinity. Thickness of the deposits ranges up to 1,000 feet. The intermediate alluvium consists of unconsolidated, poorly sorted silt and sand with lenses of gravel up to a thickness of 100 feet. These zones are moderately permeable.

The alluvial fan deposits consist of unconsolidated to poorly consolidated, partially stratified sand, gravel, and silt with lenses of clay. These deposits are generally the most permeable of the valley sedimentary deposits. The eastside alluvial fans range up to 300 feet in thickness and are considered the most important groundwater source. The upper fan areas are moderately to highly permeable and, where saturated, can yield large amounts of water to wells. The mid- to lower fans are generally less permeable but contain confined zones yielding moderate amounts of water to wells. The west side fans, ranging in thickness to 100 feet, are less permeable resulting in low to moderate well yields.

Near-shore deposits occur at the south end of the subbasin and overlie the basin in the southwest trending towards the northeast subbasin boundary. The deposits are moderately to highly permeable and may yield large quantities of water to wells.

The Pleistocene volcanic rocks consist of highly jointed flat lying basalt flows ranging from 50 to 200 feet in thickness with interbedded scoriaceous zones and pyroclastic rocks. In the surrounding upland, these rocks serve as a recharge zone; in the valley they interfinger with valley sediments and act as a forebay to water-bearing deposits. In general these rocks are highly permeable and can yield large amounts of water to wells.

The Plio-Pleistocene volcanic rocks consist of highly jointed basalt flows with some zones of scoria and interbedded pyroclastic rocks. The deposits range up to 500 feet in thickness. These rocks are generally highly permeable and are areas of recharge where exposed at the ground surface. Flows from the west side of the basin contain numerous permeable zones that likely provide large quantities of water to wells. On the east side of the basin, multiple flows of fractured lava are interbedded within the valley sedimentary deposits. Wells penetrating these rocks yield moderate to high quantities of water.

The Alturas Formation consists of slightly consolidated, well-bedded, tuffaceous sandstone and occurs at depth in the basin separating younger and older lava flows. The deposits are moderately permeable and may provide moderate amounts of confined water to deep wells. Thickness of the formation ranges up to 500 feet. In the Goose Valley Basin (including Lower Goose Valley and Fandange subbasins) groundwater storage to a depth of 500 feet is estimated to be 1,000,000 acre-feet (DWR 1963).

Major Sources of Recharge

Lower Goose Lake Valley is bounded on the north by Goose Lake, which is an intermittent lake. The lake gains water from the Lower Goose Lake Valley subbasin. The water level fluctuates and the lake has been completely dry several times since the early 1900s (DWR 1963). Davis Creek flows into the subbasin, toward Goose Lake, from the Warner Mountains. At the southern end of the subbasin, tributary streams flow south to the North Fork Pit River, exiting the subbasin.

The major sources of recharge to the Lower Goose Lake Valley subbasin are precipitation and surface runoff from the Warner Mountains. Upland recharge areas consist of permeable basalt flows of Pliocene to Pleistocene age. Precipitation and surface runoff infiltrates the basalt flows and percolates towards the valley recharging valley sediments. Most of the recharge to deeper aquifers along the east side of the California portion of Goose Lake Valley is derived from infiltration of surface water, generally along the foothill portions of stream channels. A relatively large portion of precipitation occurring along the west side of the valley infiltrates upland recharge areas (DWR 1963). Annual precipitation ranges from 15 to 17 inches. DWR estimates that recharge to Goose Lake Basin from deep percolation from applied water is 1,600 acre-feet per year.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1999. The majority (75%) of the land n Lower Goose Lake Valley is undeveloped. Twenty-five percent is Agricultural and 0.28% is Urban. Table 4-62 provides a more detailed description of the land use.

Table 4-62. Land Use in the Lower Goose Lake Valley Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Deciduous Fruits and Nuts	0.28	0.001
Grain and Hay	355	0.99
Pasture	8,452	23.51
Semiagricultural and Incidental	111	0.31
Subtotal	8,918	24.80
Urban		
Industrial	26	0.07
Urban Landscape	3.5	0.01
Urban Residential	68	0.19
Vacant	2.6	0.01
Subtotal	100	0.28
Native		
Riparian	1,350	3.75
Native Vegetation	18,924	52.63
Water	6,396	17.79
Barren and Wasteland	266	0.74
Subtotal	26,936	74.92
Total	**35,954**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Modoc County adopted a groundwater management ordinance in 2000. A key element of the ordinance requires an export permit for groundwater transfers out of the basin (DWR 2004). This subbasin falls with the area included in the Pit River Coalition.

Water Quality

Calcium bicarbonate type waters occur throughout the basin. The concentration of TDS averages 183 mg/L and ranges from 66 to 528 mg/L (DWR 2004).

Discharge Pathways and Sources of Contaminants

Fall River is the primary stream draining the northern and central-valley areas, and the Pit River is the primary stream in the easterly and southerly portion of the basin. These rivers converge at the southwestern corner of the valley near Fall River Mills and flow westward out of the valley.

Estimates of groundwater extraction for the Goose Lake Basin (including Lower Goose Lake Valley and Fandango subbasins) are based on a survey conducted by the DWR during 1997. The survey included land use and sources of water. Estimates of groundwater extraction for agricultural and municipal /industrial uses are 10,000, and 25 acre-feet respectively. We were unable to identify information about possible sources of contaminants.

Management Practices

We were unable to location information about management practices as they relate to groundwater quality for this groundwater basin.

Assessment of Data Adequacy and Need for Added Data

There is no water quality data available for subbasin.

Grays Valley Basin

General Basin Parameters

Acreage, Physiography

The Grays Valley groundwater basin is an alluvial valley located in southwest Lassen County. It resides at the western base of Crater Lake Mountain and is 5,440 acres (8 mi^2) in size. The basin is bounded by basalt of Crater Lake Mountain to the east. The basin is bounded on all other sides by Pleistocene basalt of Bogard Buttes, Cal Mountain, and Cone Mountain. Highway 44 traverses the basin.

Major Sources of Recharge

Recharge to the basin is from precipitation, lake infiltration and surface runoff. The average annual precipitation in the basin ranges from 19 to 21 inches. A lake resides in the northwest corner of the basin.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1997. Grays Valley is rather small and all of the land uses in are Native (Table 4-63).

Table 4-63. Land Use in the Long Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Native		
Native Vegetation	4,750	87.30
Water	690	12.70
Total	**5,440**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

No known groundwater management plans, groundwater ordinances, or basin adjudications.

This basin falls with the area included in the Pit River Coalition.

Water Quality

No known data.

Discharge Pathways and Sources of Contaminants

There is no known groundwater contamination in Grays Valley.

Management Practices

There is no known irrigated agriculture in Grays Valley.

Assessment of Data Adequacy and Need for Additional Data

There is no water quality data available for Grays Valley basin.

Grizzly Valley Basin

General Basin Parameters

Acreage, Physiography

The Grizzly Valley Groundwater Basin lies within a down-dropped graben bounded to the northeast by Grizzly Valley Fault and to the southwest by a series of northwest trending faults. Hot Springs Fault appears to transect the basin from the southeast to the northwest. The basin is bounded to the north by Miocene volcanic rocks and to the south by Paleozoic marine sediments, Mesozoic granitic rocks, recent volcanics, and Tertiary intrusive rocks. Grizzly Creek drains the valley and is tributary to the Middle Fork Feather River. Grizzly Creek drains the valley and is tributary to the Middle Fork Feather River. Other creeks in the basin are Freeman, Little Grizzly, Blakeless, Emigrant, Lovejoy and Cow. The area of Grizzly Valley basin is 13,440 acres and located it is in Plumas County.

Major Sources of Recharge

Recharge to the basin is from infiltration of precipitation and stream infiltration. Annual precipitation ranges from 29 to 37 inches, increasing to the west.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. Native land accounts for about 99.9% of the basin. Table 4-64 provides details of the land uses within the basin.

Table 4-64. Land Use in the Grizzly Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Urban		
Urban Residential	10	0.10
Subtotal	10	0.10
Native		
Native Vegetation	8,390	62.40
Riparian	1,440	10.70
Water	3,600	26.80
Subtotal	13,430	99.90
Total	**13,440**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

No known groundwater management plans, groundwater ordinances, or basin adjudications. No know water agencies. No urban areas.

This basin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

High Valley Basin

General Basin Parameters

Acreage, Physiography

The High Valley Basin is 4 mi^2 in size and is located in Lake County. The following description of the physiography and hydrogeology in the High Valley Basin is taken from DWR Bulletin 118 (2004).

High Valley Basin is a small, poorly drained, isolated valley in the Coast Ranges. It is nearly a closed basin, with the only outlet being the narrow gorge of Schindler Creek in the southeast corner. The valley consists of a flat alluvial plain about 3 miles long and 1 mile wide, surrounded by a narrow band of high, steeply sloping hills. The north, west, and south boundary of the High Valley Basin is generally defined as the contact between the Jurassic-Cretaceous Franciscan Formation and the valley alluvium. Baldy Mountain is located to the west, and High Valley Ridge borders the valley to the north. Quaternary Holocene volcanics border the basin to the east.

The aquifer system in High Valley Basin is comprised primarily of Quaternary alluvial deposits and Holocene volcanic deposits. The alluvium overlies a confined volcanic aquifer of Holocene age. Below the volcanic aquifer are older alluvial deposits about which there is little information.

The Quaternary alluvium consists of up to 100 feet of fine-grained lake deposits that confine an underlying volcanic aquifer. The permeability of the alluvium is generally low. The central part of the alluvial plain is bordered by alluvial fans containing coarser grained material.

Holocene volcanics likely originated from the vicinity of Round Mountain located to the east. These volcanics, which also dammed the ancestral valley, were later buried in the central portion of the valley by fine-grained alluvium reducing potential recharge on the valley floor. Most irrigation wells in the valley tap the fine-grained alluvium. Irrigation wells drilled in the volcanic aquifer system were initially productive, but after a few seasons of operation, production was reduced. One well was reported to yield about 1,000 gpm, reducing to a yield of only about 200 gpm after 4 years of production. Thickness of the formation is unknown.

Information with respect to the hydrogeology of the basin is limited. Little is known in regards to the lithology of the deeper alluvium and it's believed that the extents of the alluvium may be several miles to the east underneath the younger volcanics.

The storage capacity is estimated to be 9,000 acre-feet for a saturated depth interval of 10–100 feet. Usable storage capacity is estimated to be 900 acre-feet.

Estimates of groundwater extraction for the High Valley Basin are based on a survey conducted by the DWR in 1995. The survey included land use and sources of water. Estimates of groundwater extraction for agricultural and municipal/industrial uses are 78 and 210 acre-feet, respectively. Deep percolation from applied water is estimated to be 33 acre-feet.

Major Sources of Recharge

The source of recharge in High Valley Basin is from precipitation within the drainage area. Infiltration likely occurs at the perimeter of the valley in the alluvial fans. Annual precipitation in the valley ranges from 27 to 35 inches, decreasing to the east.

Land Use

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for about 16% of the basin, urban land use accounts for less than 2% of the basin, and native land use accounts for about 82% of the basin. Table 4-65 provides details on the distribution of land use throughout the High Valley Basin.

Table 4-65. Land Use in the High Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	3	0.11
Idle	179	7.61
Pasture	119	5.05
Semiagricultural and Incidental	22	0.95
Vineyards	64	2.71
Subtotal	388	16.44
Urban		
Industrial	36	1.54
Subtotal	36	1.54
Native		
Riparian	38	1.59
Native Vegetation	1,883	79.86
Water	13	0.57
Subtotal	1,934	82.02
Total	**2,358**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County adopted a groundwater management ordinance in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). The only public water agency in the High Valley Basin is Clearlake Oaks CWD. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

Groundwater in the basin consists of magnesium bicarbonate type waters. TDS range from 480 to 745 mg/L, averaging 598 mg/L. Impairments to water quality include locally high ammonia, phosphorus, chloride, iron, and manganese. High boron may be an issue for agricultural uses. (DWR 2004, 1975)

Discharge Pathways and Sources of Contaminants

The primary groundwater discharge pathway from the basin is Schindler Creek. We were unable to identify information about sources of contamination.

Management Practices

DWR and Lake County monitor groundwater levels in the High Valley Basin in 1 and 4 wells, respectively, on a semi-annual basis. DWR also monitors 2 wells biennially for miscellaneous water quality parameters (DWR 2004).

According to the Sacramento River Watershed Evaluation Report (Sac Coalition 2004), agricultural producers in Lake County integrate BMPs including engineered drainage systems, cover crops, soil erosion prevention programs and buffer zones. Chemical Application Methods are almost exclusively ground sprayer or chemigation. Virtually all producers use PCAs that monitor orchard and vineyard pest populations and make formal written recommendations to control damaging pests. All PCAs are registered with the State of California.

Notably, recent land use transitions away from flood-irrigation of orchards have greatly reduced the volumes of water used for irrigation. Also, drip-irrigated vineyards with non-irrigated cover crops are replacing sprinkler-irrigated orchards (Sac Coalition 2004).

Assessment of Data Adequacy and Need for Added Data

There appears to be inadequate data to develop conclusions about possible effects of irrigated agriculture on groundwater quality.

Hot Springs Valley Basin

General Basin Parameters

Acreage, Physiography

The area of Hot Springs Valley Basin is 4 mi^2 (2,400 acres) and it is located in Modoc and Shasta Counties. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004). The Hot Springs Valley Groundwater Basin is a northwest trending valley of Quaternary alluvium. The basin is bounded to the north, northeast, and northwest by Tertiary basalt of Big Valley Mountain and to the east and west by Recent basalt.

Based on 1995 and 1997 DWR surveys of land use and sources of water, groundwater extraction for municipal and industrial uses in the basin is estimated to be 1 acre-foot. Deep percolation of applied water is estimated to be 41 acre-feet.

The total depth of domestic wells in the basin range from 55 to 380 feet, with an average of 164 feet, based on 7 well completion reports. The single municipal/irrigation well completed in the basin is reported to have a total depth of 230 feet. No yield information is available for these wells.

Major Sources of Recharge

Precipitation is the major source of recharge. Annual precipitation ranges from 19 to 27 inches, increasing to the north.

Land Use

Land use surveys were conducted within the basin by DWR in 1995 and 1997. Agricultural land use accounts for about 23% of the basin and native land accounts for about 77% of the basin. Table 4-66 provides details on the distribution of land use throughout the Hot Springs Valley Basin.

Table 4-66. Land Use in the Hot Springs Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Idle	332	13.79
Pasture	230	9.58
Subtotal	562	23.36
Native		
Native Vegetation	1,839	76.46
Water	4	0.18
Subtotal	1,843	76.64
Total	**2,405**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Shasta County adopted a groundwater management ordinance in 1998 and Siskiyou County adopted a groundwater management ordinance in 1998. A key element of both of the county ordinances is the requirement of an export permit for groundwater transferred out of the basin (DWR 2004). There are no public or private water agencies in the basin. This basin falls with the area included in the Pit River Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Humbug Valley Basin

General Basin Parameters

Acreage, Physiography

Humbug Valley is a small down-dropped area within the Penman Peak-Beckwourth Peak horst northeast of Mohawk Valley. The valley is approximately 6 miles long and 3 miles wide. The valley is bounded to the north by Pliocene volcanic rocks of Penman Peak, to the southeast by Miocene volcanic rocks of Beckwourth Peak, and to the northeast by Mesozoic granitic rocks. The floor of the river canyon is composed of fairly flat alluvium and sloping lake deposits at the western end of the valley. Middle Fork Feather River flows southwesterly through the valley to Mohawk Valley. Humbug Creek and Willow Creek are major tributaries to Middle Fork Feather River. The basin is located in Plumas County and is 9,980 acres (16 mi^2) in size.

The following information regarding the hydrogeology of Humbug Valley basin is taken from DWR Bulletin118 (2004). The water-bearing formations of Humbug Valley are probably similar to those of Mohawk Valley. The primary water-bearing formations of Mohawk Valley are Holocene sedimentary deposits and Pleistocene lake deposits.

Holocene sedimentary deposits include alluvial fans and intermediate alluvium. Alluvial fans consist of unconsolidated gravel, sand, and silt with minor clay lenses. The fan deposits coalesce or interfinger with lake and alluvial deposits. Specific yield ranges from 8 to 17%. Intermediate alluvium consists of unconsolidated silt and sand with lenses of clay and gravel. Specific yield is estimated to range from 5 to 25%. Pleistocene Lake deposits consist of slightly consolidated, bedded sand, silt, and diatomaceous clay. Specific yield ranges from 1 to 25%. DWR (1963) estimates storage capacity to be 76,000 acre-feet to a depth of 100 feet.

DWR (2004) estimated groundwater extraction and percolation of applied water based on a 1997 survey. Groundwater extraction for municipal and industrial uses is estimated to be 200 acre-feet. Deep percolation of applied water is estimated to be 200 acre-feet.

Major Sources of Recharge

Recharge to the basin is from infiltration of precipitation, infiltration of irrigation water and stream infiltration. Annual precipitation in the valley ranges from 23 to 29 inches, increasing to the southwest. Middle Fork Feather River flows southwesterly through the Humbug Valley to Mohawk Valley. Humbug Creek and Willow Creek are major tributaries to Middle Fork Feather River. Deep percolation of applied water is estimated to be 200 acre-feet.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. Agricultural land use accounts for about 4% of the basin, urban land uses account for 8% of the basin and native land accounts for about 88% of the basin. Table 4-67 provides details of the land uses within the Humbug Valley basin.

Table 4-67. Land Use in the Humbug Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Pasture	430	4.32
Subtotal	430	4.32
Urban		
Commercial	30	0.30
Industrial	70	0.70
Urban Landscape	10	0.10
Urban Residential	690	6.93
Subtotal	800	8.03
Native		
Riparian	120	1.20
Native Vegetation	8,590	86.24
Water	20	0.20
Subtotal	8,730	87.65
Total	**9,960**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

No known groundwater management plans, groundwater ordinances, or basin adjudications. The cities of Portola and Delleker are located in the basin. The public water agencies in the basin are City of Portola WSA and Grizzly Lake Resort ID. This basin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

The DHS sampled wells as required by Title 22 from 1994 to 2000. Sampling was completed for inorganics (11 wells), nitrates (14 wells), pesticides (2 wells), volatile organic compounds (2 wells) and radioactive elements (4 wells). There were no confirmed detections above the MCLs.

Discharge Pathways and Sources of Contaminants

Groundwater in the Humbug Valley aquifer is pumped for use as both domestic and irrigation water.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data to determine the groundwater quality in this basin.

Indian Valley Basin

General Basin Parameters

Acreage, Physiography

The Indian Valley aquifer system is 46 mi^2 in size and is located in Plumas County. The following description of the hydrogeology of the basin is taken from DWR Bulletin 118 (2004).

The Indian Valley Groundwater Basin is an irregular shaped basin bounded by Paleozoic to Mesozoic marine, volcanic, and metavolcanic rocks. The basin includes Genessee Valley, Indian Valley, and Bucks Valley. Indian Creek flows south and drains the basin at the southwest corner.

Storage capacity is estimated to be 100,000 acre-feet for a saturated depth interval of 10–210 feet.

Major Sources of Recharge

Annual precipitation ranges from 31 to 43 inches, increasing to the southwest.

Land Use

Based on a 1997 DWR survey of land use and sources of water, groundwater extraction for municipal and industrial uses is estimated to be 100 acre-feet. Deep percolation of applied water is estimated to be 2,600 acre-feet.

Land use surveys were conducted within the basin by DWR in 1997. Agricultural land use accounts for about 39% of the basin, urban land use accounts for about 4% of the basin, and native land use accounts for about 57% of the basin. Table 4-68 provides details on the distribution of land use throughout the Indian Valley Basin.

Table 4-68. Land Uses in the Indian Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Pasture	11,401	38.76
Semiagricultural and Incidental	106	0.36
Subtotal	11,507	39.12
Urban		
Commercial	103	0.35
Industrial	128	0.44
Urban Landscape	29	0.10
Urban Residential	778	2.64
Vacant	59	0.20
Subtotal	1,097	3.73
Native		
Barren and Wasteland	185	0.63
Riparian	403	1.37
Native Vegetation	15,975	54.31
Water	246	0.84
Subtotal	16,809	57.15
Total	**29,413**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

There are no known groundwater management plans, groundwater ordinances, or basin adjudications for the Indian Valley Basin. No public or private water agencies exist within the basin (DWR 2004).

This basin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

Groundwater in the Indian Valley Basin is sampled for miscellaneous water quality parameters by DWR bi-yearly at 4 wells and by the DHS at 9 wells. Groundwater sampling performed under the requirements of the DHS Title 22 program from 1994 through 2000 tested for primary and secondary inorganics, radiologicals, nitrates, pesticides, VOCs, and SVOCs. One well of 14 sampled showed concentrations above the MCLs for secondary inorganics. Concentrations above the MCL for the other constituents were not detected (DWR 2004).

Discharge Pathways and Sources of Contaminants

Groundwater discharges primarily to Indian Creek and groundwater wells. We were unable to identify information about sources of contamination.

Management Practices

We could not find information about management practices that affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

There is generally insufficient data to develop conclusions about impacts of irrigated agriculture on groundwater quality.

Jess Valley Basin

General Basin Parameters

Acreage, Physiography

The Jess Valley groundwater basin is located in Modoc County and is 6,700 acres (10 mi^2) in size. The west side of the basin is bounded by Miocene basalt and, to a much lesser extent, Tertiary pyroclastic rocks. The basin is bounded on all other sides by Tertiary pyroclastic rocks. Jess Valley Basin consists of Quaternary alluvium and lake deposits. It drains to the west.

No hydrogeologic information is available for this basin.

DWR estimates groundwater extraction for municipal and industrial uses to be 2 acre-feet. This estimate is based on surveys conducted by the DWR during 1997.

Major Sources of Recharge

Recharge to the basin is from precipitation, irrigation infiltration, and stream infiltration. The average annual precipitation is about 17 inches. Deep percolation of applied water is estimated by DWR (2004) to be 830 acre-feet. East Creek and Mill River influence the groundwater in the Jess Valley Basin.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. The Jess Valley Basin is overlain with 53% agricultural land use, almost all of which is rangeland (pasture). Table 4-69 provides details of the land uses within the basin.

Table 4-69. Land Use in the Jess Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Pasture	3,571	53.26
Semiagricultural and Incidental	16	0.24
Subtotal	3,587	53.49
Urban		
Urban Residential	38	0.57
Subtotal	38	0.57
Native		
Riparian	213	3.17
Native Vegetation	2,868	42.77
Subtotal	3,081	45.94
Total	**6,705**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Modoc County adopted a groundwater ordinance in 2000. Groundwater ordinances generally affect the volume of groundwater that can be pumped and/or exported from the basin. A key element of the Modoc County ordinance requires an export permit for groundwater transferred out of the basin (DWR 2004). Public water agencies involved with the basin are the California Pines Community Service District, and Hot Springs Valley Irrigation District. This basin falls with the area included in the Pit River Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Joseph Creek Basin

General Basin Parameters

Acreage, Physiography

The Joseph Creek Basin is 7 mi^2 (4,450 acres) in size and is located in Modoc County. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004).

The Joseph Creek Groundwater Basin is located south of Goose Lake Groundwater Basin and west of the Warner Mountains. The basin consists of Quaternary Pleistocene non-marine deposits and Holocene alluvial deposits. The alluvial deposits are located at the southern and western boundaries of the basin along North Fork Pit River and Parker Creek. Alluvial deposits are also located centrally and at the far eastern extents of the basin. The basin is bounded by Tertiary volcanic rocks of the Warner Mountains to the north, east, and south and Pleistocene pyroclastic rocks and basalt to the south and west respectively. Additional hydrogeologic information was not available from DWR for the water-bearing formations, groundwater level trends, or groundwater storage.

Based on a 1997 DWR survey of land use and sources of water, groundwater extraction for agricultural use is estimated to be 1,300 acre-feet. Deep percolation of applied water is estimated to be 140 acre-feet.

Well completion reports in the basin showed the yield for 1 municipal/irrigation well as 400 gal/min. The total depth of the single municipal/irrigation well in the basin is 230 feet (DWR 2004).

Major Sources of Recharge

Deep percolation of applied irrigation water is estimated to be 140 acre-feet. Annual precipitation ranges from 15 to 19 inches, increasing to the east.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. Agricultural land use accounts for about 21% of the basin, and native land accounts for about 79% of the basin. Table 4-70 provides details on the distribution of land use throughout the Joseph Creek Basin.

Table 4-70. Land Use in the Joseph Creek Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Pasture	909	20.41
Semiagricultural and Incidental	12	0.27
Subtotal	921	20.67
Native		
Riparian	91	2.04
Native Vegetation	3,431	77.00
Water	13	0.29
Subtotal	3,535	79.33
Total	**4,456**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Modoc County adopted a groundwater management ordinance in 2000. A key element of the ordinance requires an export permit for groundwater transfers out of the basin (DWR 2004). There are no public or private water agencies in the basin.

This basin falls with the area included in the Pit River Coalition.

Water Quality

No water quality information was available from DWR 118 (2004). No active water quality monitoring was reported.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data for evaluation of the effects of irrigated agriculture on groundwater quality.

Lake Almanor Valley Basin

General Basin Parameters

Acreage, Physiography

The Lake Almanor Valley Basin is 11 mi^2 in size and is located in Plumas County. The basin is located along the northwest shore of Lake Almanor and consists of Quaternary lake deposits and Pleistocene non-marine sediments. The basin is bounded by Lake Almanor to the southeast and bounded on all other sides by Pliocene basalt (DWR 2004).

The storage capacity is estimated to be 45,000 acre-feet for a saturated depth interval of 10–210 feet. According to DWR 118 (2004), hydrologic information is not available for descriptions of the water-bearing formations or groundwater level trends in the basin.

Based on 18 well completion reports, the average total depth of domestic wells in the basin is 55 feet, with a range from 19 to 106 feet. The total depth of the 2 municipal/irrigation wells reported in the basin is 94 feet and 100 feet.

Major Sources of Recharge

Annual precipitation in the basin is the primary source of recharge and ranges from 31 to 37 inches, increasing to the northwest.

Land Use

Based on a 1997 DWR survey of land use and sources of water, groundwater extraction for municipal and industrial uses in the Lake Almanor Valley Basin is estimated to be 740 acre-feet. Deep percolation of applied water is estimated to be 690 acre-feet.

Land use surveys were conducted within the subbasin by DWR in 1997. Agricultural land use accounts for about 3% of the subbasin, urban land use accounts for about 3% of the subbasin, and native land use accounts for about 94% of the subbasin. Table 4-71 provides details on the distribution of land use throughout the Lake Almanor Valley Basin.

Table 4-71. Land Use in the Lake Almanor Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Pasture	1,386	19.37
Semiagricultural and Incidental	3	0.04
Subtotal	1,389	19.41
Urban		
Urban	132	1.85
Commercial	56	0.78
Industrial	319	4.45
Urban Landscape	3	0.05
Urban Residential	625	8.74
Vacant	167	2.33
Subtotal	1,302	18.20
Native		
Riparian	399	5.58
Native Vegetation	3,458	48.34
Water	606	8.47
Subtotal	4,463	62.39
Total	**7,154**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

There are no known groundwater management plans, groundwater ordinances, or basin adjudications for Lake Almanor Valley Groundwater Basin. Chester PUD is the sole public water agency in the basin.

This basin falls with the area included in the Upper Feather–Upper Yuba Coalition.

Water Quality

Calcium bicarbonate is the predominant groundwater type in the basin. TDS concentrations range from 53 to 260 mg/L, averaging 105 mg/L. Groundwater in the basin has locally high copper, iron, lead, manganese, calcium and boron.

Discharge Pathways and Sources of Contaminants

Groundwater discharge pathways are not well understood, although pumping and crop water use are key discharge mechanisms.

Management Practices

Groundwater levels are monitored semi-annually by DWR at10 wells. DWR monitors for miscellaneous water quality parameters at 4 wells biennially. The DHS monitors for miscellaneous water quality parameters at 4 wells.

Assessment of Data Adequacy and Need for Added Data

There is insufficient available data to discern possible effects of irrigated agriculture on groundwater quality.

Lake Britton Area Basin

General Basin Parameters

Acreage, Physiography

The Lake Britton Area groundwater basin is located within a west-northwest trending valley in a region of several northwest trending faults. The basin is bounded to the south by Pleistocene basalt, to the west by Tertiary andesite, and to the north by Miocene basalt and Pliocene andesite (Gay 1968; Lydon 1969). The valley is drained by the Pit River. The basin is 14,060 acres (22 mi^2) in size and is located in eastern Shasta County.

Groundwater extraction for municipal and industrial uses is estimated by DWR (2004) to be 5 acre-feet.

The 1984 DWR study of the Eastern Upland area of Shasta County showed potential groundwater limitations in the area north of State Highway 299 in the Eastern Upland planning area.

Major Sources of Recharge

Recharge to the Lake Britton Area aquifer is mostly by infiltration precipitation into the alluvium. Annual precipitation ranges from 21-43 inches, increasing to the east. DWR (2004) estimated recharge by deep percolation of applied water is estimated to be 10 acre-feet.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1999. Almost all of the land uses in the Lake Britton basin are Native land uses. Only 0.9% is Urban and 0.3% is Agricultural. Table 4-72 provides details of the land uses.

Table 4-72. Land Use in the Lake Britton Area Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Pasture	44	0.32
Subtotal	44	0.32
Urban		
Urban—unclassified	29	0.21
Urban Landscape	93	0.66
Urban Residential	6	0.04
Subtotal	128	0.91
Native		
Native Vegetation	12,508	88.95
Water	1,381	9.82
Subtotal	13,889	98.78
Total	**14,061**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Shasta County adopted a groundwater management ordinance in 1998. This ordinance requires a permit for groundwater exportation from the county.

Along with Shasta County, the Burney Water District is the only water agency that manages the water in the Lake Britton Area basin.

This basin falls with the area included in the Pit River Coalition.

Water Quality

There is not groundwater quality data for this basin. From the Shasta County General Plan and DWR Bulletin 118, there does not appear to be impairments in this groundwater basin.

Discharge Pathways and Sources of Contaminants

There is no information about groundwater discharge pathways and sources of contaminants.

Management Practices

There is no available information about how irrigated agriculture may affect groundwater quality. Agriculture occupies a very small percentage of the basin land.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data for development of conclusions about the effects of irrigated agriculture on groundwater quality.

Last Chance Creek Valley Basin

General Basin Parameters

Acreage, Physiography

The Last Chance Valley Groundwater Basin is a narrow east/west trending basin located south of Honey Lake. The basin is bounded to the south by Tertiary pyroclasitc rocks and to the north by Miocene volcanics, Mesozoic granitic rocks, and Tertiary pyroclastic rocks. Eocene basalt borders the basin in the west. Last Chance Creek drains the basin to the west. The basin is 4,660 acres (7 mi^2) in size and is located in northeastern Plumas County. There is no information about the hydrogeology of Last Chance Creek Valley basin available.

Major Sources of Recharge

Recharge to the basin is from infiltration of precipitation and stream infiltration. Annual precipitation ranges from 17 to 23 inches, increasing to the west. Last Chance Creek drains the basin to the west.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. There is no agricultural land in this basin (Table 4-73).

Table 4-73. Land Use in the Last Chance Creek Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Native		
Native Vegetation	4,190	90.11
Riparian	460	9.89
Total	**4,650**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

No known groundwater management plans, groundwater ordinances, or basin adjudications. No know water agencies. No urban areas.

This basin falls with the area included in the Upper Feather–Upper Yuba Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Little Indian Valley Basin

General Basin Parameters

Acreage, Physiography

The Little Indian Valley Basin is bounded to the northeast by the East Park Reservoir and on all other sides by Mesozoic lower Cretaceous marine sedimentary rocks and the Knoxville Formation. The basin consists of Quaternary stream terrace deposits. Faulting may transect the basin. The aquifer system is 2 mi^2 in size and is located in Lake County. According to DWR Bulletin 118 (2004), hydrogeologic information, groundwater level trends, and groundwater storage data are not available for the water bearing formations.

Major Sources of Recharge

Annual precipitation is approximately 21 inches.

Land Use

Based on a 1993 DWR survey of land use and sources of water, groundwater extraction for municipal and industrial uses is estimated to be 34 acre-feet. Deep percolation of applied water is estimated to be 25 acre-feet.

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for about 25% of the basin, urban land use accounts for about 38% of the basin, and native land use accounts for about 37% of the basin. Table 4-74 provides details on the distribution of land use throughout the Little Indian Valley Basin.

Table 4-74. Land Use in the Little Indian Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Grain and Hay	305	24.06
Semiagricultural and Incidental	10	0.79
Subtotal	316	24.86
Urban		
Urban Residential	480	37.81
Subtotal	480	37.81
Native		
Riparian	6	0.51
Native Vegetation	466	36.71
Water	1	0.11
Subtotal	474	37.33
Total	**1,270**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County adopted a groundwater management ordinance in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). There are no public or private water agencies located within the Little Indian Valley Basin. This basin falls with the area included in the Colusa Coalition.

Water Quality

There is insufficient groundwater quality information was available from DWR (2004). DHS sampled only one well for inorganic and one well for nitrates between the years of 1994 and 2000.

Discharge Pathways and Sources of Contaminants

There is no readily available information on groundwater discharge pathways and sources of contaminants.

Management Practices

Lake County adopted a groundwater management ordinance for the Little Indian Valley Basin in 1999.

According to the Sacramento River Watershed Evaluation Report (Sac Coalition 2004), agricultural producers in Lake County integrate BMPs including engineered drainage systems, cover crops, soil erosion prevention programs and buffer zones. Chemical Application Methods are almost exclusively ground sprayer or chemigation. Virtually all producers use PCAs that monitor orchard and vineyard pest populations and make formal written recommendations to control damaging pests. All PCAs are registered with the State of California.

Notably, recent land use transitions away from flood-irrigation of orchards have greatly reduced the volumes of water used for irrigation. Also, drip-irrigated vineyards with non-irrigated cover crops are replacing sprinkler-irrigated orchards. (Sac Coalition 2004.)

Assessment of Data Adequacy and Need for Added Data

There is insufficient information for the development of conclusions about effects of irrigated agriculture on groundwater quality.

Long Valley Basin (5-31)

General Basin Parameters

Acreage, Physiography

The Long Valley Basin is 4 mi^2 in size and is located in Lake County. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004).

Long Valley Groundwater Basin is located within a narrow elongated valley northeast of Clear Lake. The basin is bounded on most sides by the Franciscan Formation. A small portion of the southern boundary consists of Quaternary volcanic rocks. The valley is drained by Long Valley Creek, which is tributary to North Fork Cache Creek. Groundwater is developed in Quaternary alluvium and, to a limited extent, Quaternary terrace deposits.

Major Sources of Recharge

Annual precipitation ranges from 27 to 33 inches, increasing to the west.

Land Use

Estimates of groundwater extraction are based on a survey conducted by the DWR in 1995. The survey included land use and sources of water. Estimates of groundwater extraction for agricultural and municipal/industrial uses are 760 and 23 acre-feet respectively. Deep percolation from applied water is estimated to be 210 acre-feet.

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for about 32% of the basin, urban land use accounts for about 6% of the basin, and native land use accounts for about 61% of the basin. Table 4-75 provides details on the distribution of land use throughout the Long Valley Basin.

Table 4-75. Land Use in the Long Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	44	1.56
Grain and Hay	523	18.68
Idle	206	7.36
Semiagricultural and Incidental	20	0.71
Truck, Nursery, and Berry Crops	117	4.16
Subtotal	910	32.46
Urban		
Urban Residential	175	6.25
Subtotal	175	6.25
Native		
Native Vegetation	1,715	61.23
Water	2	0.05
Subtotal	1,717	61.29
Total	**2,802**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County adopted a groundwater management ordinance for Long Valley Basin in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). County of Lake is the only public water agency within the basin. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

No information regarding water quality in the basin was available from DWR (2004).

Discharge Pathways and Sources of Contaminants

Drainage for the basin is via Long Valley Creek, which is tributary to North Fork Cache Creek.

Management Practices

According to the Sacramento River Watershed Evaluation Report (Sac Coalition 2004), agricultural producers in Lake County integrate BMPs including engineered drainage systems, cover crops, soil erosion prevention programs and buffer zones. Chemical Application Methods are almost exclusively ground sprayer or chemigation. Virtually all producers use PCAs that monitor orchard and vineyard pest populations and make formal written recommendations to control damaging pests. All PCAs are registered with the State of California.

Notably, recent land use transitions away from flood-irrigation of orchards have greatly reduced the volumes of water used for irrigation. Also, drip-irrigated vineyards with non-irrigated cover crops are replacing sprinkler-irrigated orchards. (Sac Coalition 2004)

Assessment of Data Adequacy and Need for Added Data

There is insufficient data for the development of conclusions about irrigated agriculture and groundwater quality.

Long Valley Basin (5-44)

General Basin Parameters

Acreage, Physiography

The Long Valley groundwater basin is an alluvial filled valley located in eastern Modoc and Lassen Counties. Total acreage is 1,090 acres (2 mi^2). The basin is bounded on the west side by a north/south trending fault. The basin is bounded on the northern half of the west side of the valley by Tertiary pyroclastic rocks and on all other sides by Miocene basalt.

Major Sources of Recharge

The primary source of groundwater recharge is precipitation and surface runoff. The average annual precipitation in the basin ranges from 25 to 27 inches.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1997. According to the survey, native vegetation is the only category of land use in the Long Valley Basin.

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Modoc County adopted a groundwater ordinance in 2000. Groundwater ordinances generally affect the volume of groundwater that can be pumped and/or exported from the basin. A key element of the Modoc County ordinance requires an export permit for groundwater transferred out of the basin (DWR 2004).

This basin falls with the area included in the Pit River Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Lower Lake Basin

General Basin Parameters

Acreage, Physiography

The Lower Lake Basin is bounded on the south by Plio-Pleistocene Cache Formation, Tertiary bedrock, and rocks of the Great Valley Sequence; on the north by the Cache Formation and Quaternary volcanics; and on the east by Tertiary rock of the Martinez and Tejon formations. The area of the basin is 4 mi^2 and it is located in Lake County.

The following description of the hydrogeology in the Lower Lake Basin is taken from DWR Bulletin 118 (2004). Lower Lake Basin is located at the southeast end of Clear Lake and includes the alluvial plains of Cache, Herndon, and Seigler Canyon Creeks. Copsey Creek also drains to Cache Creek from Excelsior Valley located to the south. The basin is Surficial Cache Formation and Martinez Formation deposits are located within the middle third of the basin north and northeast of the city of Lower Lake. The aquifer system of Lower Lake Basin is primarily composed of deposits of Quaternary alluvium and the Plio-Pleistocene Cache Formation.

Alluvial deposits in the basin are approximately 50–75 feet thick and consist of clay, silt, and sand, with some gravel. Irrigation wells constructed in the vicinity of alluvial deposits yield between 400 and 600 gpm with little drawdowns. The alluvial plain of Herndon Creek likely consists of clay, clay and gravel, and some interbedded gravel stringers or layers. Wells installed to depths of approximately 75 feet yield up to 250 gpm with about 40 feet of drawdown.

The Cache Formation is primarily composed of gravel, silt, and sand with the upper most sediments consisting of water-laid tuffs and tuffaceous sands intercalated with clay, marl, pebbly limestone, and diatomite. The formation underlies younger alluvial deposits over a region of approximately two-thirds of the basin. The permeability in the formation is variable but generally low. Most of the strata are too high in clay or silt. Depth of the formation is unknown. Well yields are reported to range between 150 and 240 gpm.

Storage capacity is estimated to range from 3,000 to 4,000 acre-feet. Additional storage capacity is available as part of the Cache Formation; however, thickness and specific yield of that formation is unknown.

Major Sources of Recharge

Groundwater recharge is derived from precipitation and from seepage from Herndon Creek and Clear Lake. Recharge also likely occurs from Copsey and Seigler Canyon creeks. Recharge of groundwater in the Cache formation is likely derived from the infiltration of rain that falls on the outcrop area. Annual precipitation in the basin is approximately 27 inches.

Land Use

Estimates of groundwater extraction for Lower Lake Basin are based on a survey conducted by the DWR in 2001. The survey included land use and sources of water. Estimates of groundwater extraction for agricultural and municipal/industrial uses are 78 and 210 acre-feet respectively. Deep percolation from applied water is estimated to be 33 acre-feet.

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for about 7% of the basin, urban land use accounts for about 27% of the basin, and native land accounts for about 66% of the basin. Table 4-76 provides details on the distribution of land use throughout the Lower Lake Basin.

Table 4-76. Land Use in the Lower Lake Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	91	3.76
Grain and Hay	18	0.76
Idle	19	0.80
Semiagricultural and Incidental	3	0.11
Vineyards	31	1.29
Subtotal	162	6.73
Urban		
Commercial	52	2.18
Industrial	6	0.25
Urban Landscape	5	0.20
Urban Residential	572	23.76
Vacant	11	0.44
Subtotal	645	26.83
Native		
Riparian	4	0.16
Native Vegetation	1,371	57.00
Water	223	9.28
Subtotal	1,598	66.44
Total	**2,406**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County adopted a groundwater management ordinance for Lower Lake Basin in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR

2004). Highlands Mutual Water Company is a private water agency within the basin. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

Bicarbonate type waters with mixed cationic character are found in the basin. TDS concentrations range from 290 to 1,230 mg/L, averaging 568 mg/L. Groundwater in the basin has localized high iron, manganese, calcium, sodium, ASAR, sulfate, and TDS. High boron concentrations may be an issue for irrigation (DWR 2004). Groundwater sampling performed under the requirements of the DHS Title 22 program from 1994 through 2000 tested for primary and secondary inorganics, radiologicals, nitrates, and pesticides. Two wells of 3 sampled showed concentrations above the MCLs for secondary inorganics. There were no detections above the MCL for the other constituents were not detected.

Discharge Pathways and Sources of Contaminants

There was no available information on sources of contaminants.

Management Practices

Groundwater in the Lower Lake Basin is sampled for miscellaneous water quality parameters semi-annually at 3 wells by DWR, and biennially at 5 wells by the DHS.

Lake County adopted a groundwater management ordinance for Lower Lake Basin in 1999.

According to the Sacramento River Watershed Evaluation Report (Sac Coalition 2004), agricultural producers in Lake County integrate BMPs including engineered drainage systems, cover crops, soil erosion prevention programs and buffer zones. Chemical Application Methods are almost exclusively ground sprayer or chemigation. Virtually all producers use PCAs that monitor orchard and vineyard pest populations and make formal written recommendations to control damaging pests. All PCAs are registered with the State of California.

Assessment of Data Adequacy and Need for Added Data

There is insufficient available data for the development of conclusions about effects of the small acreage of irrigated agriculture on groundwater quality.

McCloud Area Basin

General Basin Parameters

Acreage, Physiography

The McCloud Area Groundwater Basin is located at the base of Mount Shasta on the southeast slope. It is in Siskiyou County and is 21,320 acres ($33mi^2$) in size. Elevation of the basin ranges from 3,060 feet mean sea level in the south to 6,000 feet mean sea level in the north. The basin is bounded to the west by Pleistocene volcanic rocks and glacial deposits of Mount Shasta. The basin is bounded to the north by Pliocene basalt, to the east by Pliocene basalt and Pleistocene volcanic rocks, and to the south by Paleozoic marine sedimentary and metasedimentary rocks (DWR 2004).

Major Sources of Recharge

Recharge to the subbasin is from precipitation (49 to 55 inches/year), irrigation infiltration, and stream infiltration.

There are numerous creeks that drain Mount Shasta and enter the basin, such as Squaw Valley Creek, Mud Creek, Ash Creek and Pilgrim Creek. The McCloud River drains the basin to the south.

DWR estimated groundwater extraction for agricultural to be 3 acre-feet. Municipal and industrial use is approximately 420 acre-feet. Deep percolation of applied water is estimated to be 280 acre-feet. These estimates were based on a survey conducted in 1991.

Land Use

Land use surveys were conducted within the basin by DWR in 2000. Native land use accounts for about 98% of the basin. The City of McCloud is on the western basin boundary but does not lie entirely within the basin. The population of McCloud (as of 2000) is about 1,300. Table 4-77 provides details of the land uses within the basin.

Table 4-77. Land Use in the McCloud Area Groundwater Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Pasture	77	0.36
Subtotal	77	0.36
Urban		
Commercial	42	0.19
Industrial	143	0.67
Urban Landscape	74	0.35
Urban Residential	118	0.55
Vacant	45	0.21
Subtotal	422	1.98
Native		
Native Vegetation	20,835	97.66
Subtotal	20,835	97.66
Total	**21,334**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Siskiyou County adopted a groundwater management ordinance in 1998. The City of McCloud is the only large town (population 1,300) in the basin; it is located on the western basin boundary. The McCloud CSD is the only public water agencies within the basin.

This basin falls with the area included in the Pit River Coalition.

Water Quality

There is no groundwater quality information available for the McCloud Area Basin. However, since 98% of the land is native vegetation, there is little likelihood of human induced groundwater contamination.

Discharge Pathways and Sources of Contaminants

The McCloud Area Basin is adjacent to the Modoc Plateau Pleistocene Volcanic Area. The McCloud River drains the basin to the south.

Management Practices

No information.

Assessment of Data Adequacy and Need for Added Data

There is no groundwater quality information available for the McCloud Area Basin in DWR Bulletin 118 or other sources. Since 98% of the land is native vegetation, there is little likelihood of human induced groundwater contamination.

Meadow Valley Basin

General Basin Parameters

Acreage, Physiography

The Meadow Valley Groundwater Basin is 9 mi^2 (5,730 acres) in size and is located in Plumas County. The following description of the hydrogeology in the Meadow Valley Basin is taken from DWR Bulletin 118 (2004).

The basin lies within the Melones Fault Zone of the Sierra Nevada Mountain Range. It is bounded on the west by Mesozoic ultrabasic intrusive rocks, to the north and south by Pliocene pyroclastic rocks, and to the east by ultrabasic intrusive rocks and Paleozoic marine sediments.

Hydrogeologic information was not available from DWR for the water-bearing formations, groundwater level trends, and groundwater storage in the basin. Based on a 1997 DWR survey of land use and sources of water, groundwater extraction for municipal and industrial uses in the Meadow Valley Basin is estimated to be 27 acre-feet. Deep percolation of applied water is estimated to be 60 acre-feet.

The total depth of domestic wells (based on 151 well completion reports) in the basin ranged from 50 to 310 feet, with an average of 125 feet. There is no known data on well yields.

Major Sources of Recharge

The major source of groundwater recharge is precipitation, which ranges from 47 to 53 inches per year, increasing to the southwest.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1997. Agricultural land use accounts for about 5% of the subbasin, urban land use accounts for about 6% of the subbasin, and native land accounts for almost 90% of the subbasin. Table 4-78 provides details on the distribution of land use throughout the Meadow Valley Basin.

Table 4-78. Land Use in the Meadow Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Pasture	274	4.78
Subtotal	274	4.78
Urban		
Commercial	18	0.31
Urban Landscape	3	0.05
Urban Residential	303	5.28
Subtotal	323	5.63
Native		
Native Vegetation	5,132	89.49
Water	5	0.10
Subtotal	5,138	89.58
Total	**5,735**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

There are no known groundwater management plans, groundwater ordinances, or basin adjudications for the Meadow Valley Basin. There are no public or private water agencies.

This basin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

Groundwater samples from one well were analyzed for primary inorganics, radiologicals, nitrates, and secondary inorganics as required under DHS Title 22 program from 1994 to 2000. There were no detections of these constituents above the MCLs in the well sampled.

Discharge Pathways and Sources of Contaminants

There was no available data for groundwater discharge mechanisms and sources of contaminants.

Management Practices

The DHS monitors one well in the Meadow Valley Basin for miscellaneous water quality parameters.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data for development of conclusions about effects of irrigated agriculture on groundwater quality. Given the small acreage of irrigated agriculture in the basin, it is unlikely that there are substantial effects.

Middle Creek Basin

General Basin Parameters

Acreage, Physiography

The Middle Creek Groundwater Basin is 1 square mile in size and is located in Lake County.

The Middle Creek Groundwater Basin is a north-trending basin located west of Pitney Ridge and east of Middle Mountain (DWR 2004). The basin consists of Quaternary alluvium and is likely in hydraulic continuity with the Upper Lake Groundwater Basin. Faulting may extend the length of the western boundary. The basin is bounded to the north and east by the Franciscan Formation. Much of the western portion of the basin is bounded by Lower Cretaceous marine deposits.

According to DWR (2004), hydrogeologic information is not available for the water-bearing formations, groundwater level trends, or groundwater storage.

Well completion reports in the basin showed a yield for 1 municipal/irrigation well of 75 gal/min. The average total depth of domestic wells (31 wells reported) is 108 feet, with a range from 31 to 250 feet. The average total depth of municipal/irrigation wells (3 wells reported) is 70 feet, with a range from 54 to 100 feet (DWR 2004).

Major Sources of Recharge

Annual precipitation is the major source of recharge and ranges from 43 to 45-inches, increasing to the north.

Land Use

According to a 1995 DWR survey of land use and sources of water, groundwater extraction for agricultural use is estimated to be 28 acre-feet. Deep percolation of applied water is estimated to be 6 acre-feet.

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for about 5% of the basin, urban land use accounts for about 4% of the basin, and native land use accounts for about 91% of the basin. Table 4-79 provides details on the distribution of land use throughout the Middle Creek Basin.

Table 4-79. Land Use in the Middle Creek Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	18	2.53
Pasture	18	2.51
Semiagricultural and Incidental	1	0.15
Subtotal	37	5.19
Urban		
Commercial	25	3.61
Industrial	1	0.12
Urban Residential	1	0.12
Subtotal	27	3.85
Native		
Barren and Wasteland	140	19.84
Native Vegetation	502	71.12
Subtotal	641	90.96
Total	**705**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County adopted a groundwater management ordinance in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). There are no public or private water agencies in the basin. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

The DHS monitors one well in the Middle Creek Basin for miscellaneous water quality parameters but there is no available groundwater quality data.

Discharge Pathways and Sources of Contaminants

There is no available data for sources of contaminants.

Management Practices

Lake County adopted a groundwater management ordinance in 1999.

According to the Sacramento River Watershed Evaluation Report (Sac Coalition 2004), agricultural producers in Lake County integrate BMPs including engineered drainage systems, cover crops, soil erosion prevention programs and buffer zones. Chemical Application Methods are almost exclusively ground sprayer or chemigation. Virtually all producers use PCAs that monitor orchard and vineyard pest populations and make formal written recommendations to control damaging pests. All PCAs are registered with the State of California.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data about effects of irrigated agriculture on groundwater quality. Given the small acreage, effects are unlikely.

Middle Fork Feather River Basin

General Basin Parameters

Acreage, Physiography

The Middle Fork Feather River Groundwater Basin is 7 mi^2 (4,340 acres) in size and is located in Plumas County. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004).

The Middle Fork Feather River Groundwater Basin consists of Quaternary lake and alluvial deposits. The basin is located within a region of northwest trending faults. A fault forms a basin boundary to the east. The basin is bounded to the north and south by Pliocene and Miocene volcanic rocks and to the east and west by Paleozoic marine deposits. The alluvial deposits in the basin are largely located along the North Fork Feather River, which drains the basin to the southwest.

Hydrogeologic information was not available from DWR for the water-bearing formations, groundwater level trends, and groundwater storage in the Middle Fork Feather River Basin.

Based on a 1997 DWR survey of land use and water sources, groundwater extraction for municipal/industrial use is estimated to be 4 acre-feet. Deep percolation of applied water is estimated to be 34 acre-feet.

Total depth of domestic wells in the basin ranges from 23 feet to 400 feet, with an average of 150 feet. There is no known data on well yields.

Major Sources of Recharge

Precipitation is the primary source of recharge with annual precipitation ranging from 39 to 47-inches, increasing to the west.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1997. Agricultural land use accounts for about 4% of the subbasin, urban land use accounts for about 2% of the subbasin, and native land use accounts for about 94% of the subbasin. Table 4-80 provides details on the distribution of land use throughout the Middle Fork Feather River Basin.

Table 4-80. Land Use in the Middle Fork Feather River Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Pasture	161	3.70
Semiagricultural and Incidental	7	0.15
Subtotal	167	3.86
Urban		
Commercial	82	1.88
Industrial	13	0.30
Urban Landscape	3	0.06
Urban Residential	4	0.10
Subtotal	102	2.34
Native		
Native Vegetation	4,027	92.77
Water	45	1.04
Subtotal	4,072	93.80
Total	**4,341**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

There are no known groundwater management plans, groundwater ordinances, or basin adjudications for the basin. There are no known public or private water agencies in the basin.

This basin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

Groundwater samples were analyzed for primary inorganics, nitrates, and secondary inorganics as required under DHS Title 22 program from 1994 to 2000. There were no detections of these constituents above the MCLs in the wells sampled (DWR 2004).

Discharge Pathways and Sources of Contaminants

There is no information about sources of contaminants.

Management Practices

There is no information about management practices related to groundwater quality.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data for evaluating effects of irrigated agriculture on groundwater quality. However, the small agricultural acreage and lack of water-quality problems indicates minimal probability of groundwater contamination.

Mohawk Valley Basin

General Basin Parameters

Acreage, Physiography

The Mohawk Valley Groundwater Basin encompasses 30 mi^2 and is located in Plumas and Sierra Counties. The following description of the hydrogeology in the Mohawk Valley Basin is taken from DWR Bulletin 118 (2004).

The Mohawk Valley Groundwater Basin lies within an elongated valley occupying a portion of a long, narrow graben. The graben is bounded on the southwest side by the Mohawk Valley fault. The east side of the valley is bounded by a group of northwest trending faults that branch from the Mohawk Valley fault near Gattley. The floor of the valley consists of a narrow strip of nearly flat alluvial material overlying lake sediments. Lake sediments also underlie the upland areas of the valley. Depth to bedrock is estimated to range from 1,500 to 3,000 feet. The basin is bounded to the northeast by Pliocene volcanic rocks of Penman Peak, to the east by Miocene volcanic rocks of Beckwourth Peak, and to the west and southwest by Paleozoic metavolcanic rocks and Mesozoic granitic rocks of the Sierra Nevadas. Sulphur Creek drains the southern half of the valley and enters Middle Fork Feather River near the midpoint of the valley and flows northwesterly.

The primary water-bearing formations in the basin are Holocene sedimentary deposits and Pleistocene lake and near-shore deposits. Holocene sedimentary deposits include alluvial fans and intermediate alluvium. Alluvial fans consist of unconsolidated gravel, sand, and silt with minor clay lenses. Thickness of the deposits ranges to 200 feet. The fan deposits coalesce or interfinger with lake and alluvial deposits. Specific yield ranges from 8 to 17%.

Intermediate alluvium consists of unconsolidated silt and sand with lenses of clay and gravel. Specific yield is estimated to range from 5 to 25%. This unit is limited in extent. The deposits are up to 50 feet in thickness and yield moderate amounts of groundwater.

Lake and near-shore deposits underlie the majority of the valley and range in thickness to over 2,000 feet. These deposits consist of slightly consolidated, bedded sand, silt, and diatomaceous clay. The sand beds usually yield large quantities of confined groundwater. The near-shore deposits are composed of moderately permeable sand and gravel and, where saturated, yield moderate amounts of groundwater. Specific yield ranges from 1 to 25%.

Storage capacity for the basin is estimated to be 90,000 acre-feet based on a specific yield of 5% for a depth interval of zero to 200 feet

Major Sources of Recharge

Precipitation is the primary source of recharge and annually ranges from 27 to 39 inches in the valley and ranges to 51 inches in the upland areas (DWR 2004).

Land Uses

Based on a 1997 DWR survey of land use and sources of water, groundwater extraction for municipal and industrial uses is estimated to be 130 acre-feet. Deep percolation of applied water is estimated to be 330 acre-feet (DWR 2004).

Land use surveys were conducted within the basin by DWR in 1997. Agricultural and urban land use each account for about 7% of the basin, and native land use accounts for over 85% of the basin. Table 4-81 provides details on the distribution of land use throughout the Mohawk Valley Basin.

Table 4-81. Land Use in the Mohawk Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Pasture	1,337	7.04
Semiagricultural and Incidental	4	0.02
Subtotal	1,341	7.07
Urban		
Commercial	98	0.52
Urban Landscape	515	2.71
Urban Residential	809	4.26
Subtotal	1,422	7.49
Native		
Native Vegetation	16,122	84.93
Water	99	0.52
Subtotal	16,220	85.45
Total	**18,983**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

There are no known groundwater management plans, groundwater ordinances, or basin adjudications pertaining to the Mohawk Valley Basin. Public Water agencies within the basin include Plumas Eureka CSD and CLIO PUD.

This basin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

Calcium-magnesium bicarbonate and sodium bicarbonate are the predominant groundwater types in the basin. TDS ranges from 210 to 285 mg/L, averaging 248 mg/L. Groundwater in the basin has locally high iron, manganese, ammonia, phosphorus, ASAR and boron levels.

Groundwater sampling performed under the requirements of the DHS Title 22 program from 1994 through 2000 tested for primary and secondary inorganics, radiologicals, nitrates, pesticides, VOCs, and SVOCs. Five wells of 11 sampled for secondary inorganics showed concentrations above the MCLs. Concentrations above the MCL for the other constituents were not detected (DWR 2004).

Discharge Pathways and Sources of Contaminants

There was no information about sources of contaminants of discharge pathways.

Management Practices

DWR monitors groundwater levels in the Mohawk Valley Groundwater Basin at one well semi-annually. Groundwater is tested for miscellaneous water quality parameters at 2 wells biennially by DWR and at 15 wells by the DHS. There is no available information about management practices related to groundwater quality.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data to develop conclusions about effects of irrigated agriculture on groundwater quality. However, the small acreage of irrigated agriculture indicates there is little potential for groundwater quality degradation due to irrigated agriculture.

Mountain Meadows Basin

General Basin Parameters

Acreage, Physiography

The Mountain Meadows Valley Groundwater Basin is located to the northeast of Lake Almanor. The basin consists of Quaternary alluvium that encircles Mountain Meadow Reservoir. The basin is bounded to northeast by Jurassic to Triassic metavolcanic rocks and Tertiary non-marine sediments. The basin is bounded to the southeast by Miocene volcanic rocks and to the northwest by Pleistocene basalt. The area of the subbasin is 8,150 acres (13 mi^2) and is located in Lassen County.

There is no available information about the hydrogeology of Mountain Meadows basin.

DWR estimated the groundwater extraction for the Mountain Meadows Valley Basin from a 1997 survey. The survey included land use and sources of water. Groundwater extraction for municipal and industrial uses was estimated to be 7 acre-feet annually. Deep percolation of applied water was estimated to be 350 acre-feet annually.

Major Sources of Recharge

Recharge to the subbasin is from precipitation (18 inches/year), irrigation infiltration and stream infiltration. Annual precipitation in the basin ranges from 35 to 39 inches. Deep percolation of applied water is estimated to be 350 acre-feet per year. Streams in the basin are Roberts Creek, Deerheart Creek, Mountain Meadows Creek, and Greenville Creek.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. Agricultural land use accounts for about 46% of the area and undeveloped land accounts for about 54% of the basin. Table 4-82 provides details of the land uses within the basin.

Table 4-82. Land Use in the Mountain Meadows Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Pasture	3,740	45.89
Subtotal	3,740	45.89
Urban		
Industrial	10	0.12
Subtotal	10	0.12
Native		
Riparian	1,630	20.00
Native Vegetation	2,660	32.64
Water	110	1.35
Subtotal	4,400	53.99
Total	**8,150**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lassen County enacted a groundwater ordinance in 1999 that requires a permit for groundwater exported from the county. No known groundwater management plans or basin adjudications. This basin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

North Fork Battle Creek Basin

General Basin Parameters

Acreage, Physiography

The North Fork Battle Creek basin is bounded to the north by Pliocene volcanic rock and on all other sides by Pleistocene volcanic basalt (Gay 1960). The basin consists of several east-west trending courses of alluvium located along North Fork Battle Creek and Bailey Creek. The areal extent of the basin is 12,760 acres (20 mi^2) and is located in eastern Shasta County.

The following description of the hydrogeology in the North Fork Battle Creek basin is taken from DWR Bulletin 118 (DWR 2004). Water-bearing formations in the basin include the Quaternary alluvium and underlying volcanic rocks. Driller reports for wells located in the area of Viola (along the eastern basin boundary) show uniform stratification of alluvium and volcanic rocks. The reports indicate that alluvium is approximately 32 feet thick overlying a succession of volcanic rocks (DWR 1984). The volcanic rocks are composed of two 10–40-foot thick flows that are separated by a 40–80-foot section of sand, gravel, ash, and cinders. DWR (1984) indicates that the interbedded sand-gravel-ash-cinder strata are the primary groundwater source in the area. DWR (1984) reports that groundwater in the area of Viola has a seasonal fluctuation of 1 foot with the lowest elevations occurring during periods of maximum evapotranspiration.

Major Sources of Recharge

Recharge to the principal aquifer is mostly by infiltration of streamflows at the margins of the subbasin. Other sources of recharge are infiltration of applied water and direct infiltration of precipitation (43-49 inches/yr) into the alluvium. DWR (2004) estimated annual groundwater extraction for municipal and industrial use to be 190 acre-feet. Inflow via deep percolation of applied water is estimated to be 220 acre-feet.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1999. North Fork Battle Creek basin contains 90% Native land, 6% Agricultural land, and 4% urban land. Table 4-83 provides details of the land uses within the subbasin.

Table 4-83. Land Use in the North Fork Battle Creek Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Pasture	751	5.89
Subtotal	751	5.89
Urban		
Urban	6	0.05
Commercial	49	0.39
Urban Residential	426	3.34
Subtotal	482	3.78
Native		
Riparian	33	0.26
Native Vegetation	11,458	89.78
Water	38	0.29
Subtotal	11,529	90.34
Total	**12,762**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Shasta County adopted a groundwater management ordinance in 1998. This ordinance requires a permit for groundwater exportation from the county. There are no water agencies involved with the management of North Fork Battle Creek basin. This basin falls with the area included in the Shasta Tehama Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

North Fork Cache Creek Basin

General Basin Parameters

Acreage, Physiography

The area of the North Fork Cache Creek Groundwater Basin is 5 mi^2 the basin and is located in Lake County. The following description of the North Fork Cache Creek Basin is taken from DWR Bulletin 118 (2004).

The North Fork Cache Creek Groundwater Basin is a north-south trending basin consisting of Quaternary alluvium and stream terrace deposits. The basin is bounded by Mesozoic ultrabasic intrusive rocks in the north. Other sides of the basin are bounded by Franciscan Formation metasediments and Franciscan volcanic and metavolcanic rocks. The valley is drained to the south by North Fork Cache Creek.

According to DWR (2004), hydrogeologic information was not available for the water-bearing formations, groundwater level trends, or storage in the basin.

Major Sources of Recharge

The primary source of recharge is precipitation which annual ranges from 23 to 25 inches, increasing to the south.

Land Use

Land use surveys were conducted within the basin by DWR in 2001. Native land use accounts for 100% of the basin. Table 4-84 provides details on the distribution of land use throughout the North Fork Cache Creek Basin.

Table 4-84. Land Use in the North Fork Cache Creek Basin

Land Use	Acreage of Land Use	Percent of Land Use
Native		
Barren and Wasteland	545	15.69
Native Vegetation	107	3.08
Water	2,824	81.23
Total	**3,477**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County adopted a groundwater management ordinance in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). There are no public or private water agencies within the basin. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Pope Valley Basin

General Basin Parameters

Acreage, Physiography

The areal extent of the Pope Valley Basin aquifer system is 11 mi^2 and is located in Napa County. The following description of the hydrogeology is taken from DWR Bulletin 118 (2004).

The Pope Valley groundwater basin occupies a northwest trending structural depression in the central Coast Ranges, approximately 5 miles east of Lake Berryessa. The Pope Valley is approximately 9 miles in length from its northwestern boundary near the town of Aetna Springs to its southeastern margin near the confluence of Maxwell and Hardin Creeks. The basin ranges in width, up to 2 miles. Mountains of the Coast Ranges surround the Pope Valley Basin on all sides. The boundary between the water-bearing and nonwater- bearing materials roughly coincides with the edge of the valley floor. Pope and Maxwell Creeks drain the Pope Valley groundwater basin.

The Quaternary alluvium within the Pope Valley groundwater basin is considered the principal water bearing deposit.

Historically, stream development has been limited to small creeks. Since large stream flows were lacking, accumulations of alluvium seem to have been restricted to the range of 25 feet to 30 feet.

The alluvial material is principally composed of silty to clayey sands and gravels. With an assumed specific yield of 3% most wells yield less than 100 gpm.

Small outcrops of the Sonoma Volcanics of Pliocene age occur in the vicinity of Aetna Springs. They are considered to be water bearing but their limited distribution restricts the quantity of groundwater that can be extracted from them to insignificant proportions.

Bedrock beneath the Pope Valley groundwater basin is comprised predominantly of Lower Cretaceous marine sedimentary rocks, which is also found cropping out in the surrounding hills.

According to DWR (2004), there is no published information found that is indicative of groundwater level trends, quantity of groundwater in storage, or groundwater extraction for the Pope Valley groundwater basin. Groundwater storage capacity for the Pope Valley groundwater basin is estimated to contain 7,000 acre-feet of water.

The average total depth of domestic wells in the Pope Valley Basin is 169 feet, with a range from 21 to 600 feet. The average total depth of municipal/irrigation wells is 194 feet, with a range from 60 to 300 feet (DWR 2004).

Major Sources of Recharge

Natural recharge occurs from infiltration of precipitation that falls on the basin floor and in the upland areas within the drainage basin of the valley. The annual precipitation ranges from less than 36 inches in the southeast to more than 40 inches in the northwest (DWR 2004).

Land Use

Land use surveys were conducted within the basin by DWR in 1999. Agricultural land use accounts for about 32% of the basin, urban land use accounts for about 1% of the basin, and undeveloped land accounts for almost 68% of the basin. Table 4-85 provides details on the distribution of land use throughout the Pope Valley Basin.

Table 4-85. Land Use in the Pope Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	16	0.23
Grain and Hay	197	2.74
Idle	226	3.15
Rice	3	0.04
Semiagricultural and Incidental	29	0.41
Vineyards	1,796	25.01
Subtotal	2,268	31.58
Urban		
Urban—unclassified	5	0.06
Commercial	12	0.16
Urban Landscape	34	0.47
Urban Residential	4	0.06
Vacant	9	0.12
Subtotal	63	0.88
Native		
Riparian	9	0.13
Native Vegetation	4,583	63.80
Water	259	3.60
Subtotal	4,851	67.54
Total	**7,182**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Napa County Flood Control and Water Conservation District is a public water agency within the Pope Valley Basin. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

According to DWR (2004) there is no published data found to characterize the groundwater quality of the Pope Valley groundwater basin. The DHS monitors 1 well in the basin for Title 22 water quality parameters.

Discharge Pathways and Sources of Contaminants

There was no available data for sources of contaminants in the basin.

Management Practices

There was no information about management practices that affect groundwater quality in this basin.

Assessment of Data Adequacy and Need for Added Data

There is insufficient information about possible effects of irrigated agriculture in this basin.

Redding Basin—Introduction

Organization and Elements

The Redding Basin covers about 510 mi^2 in the northern part of the Central Valley of California and is surrounded by the Cascade Range, Klamath Mountains, and Coast Ranges. It is separated from the main part of the valley by the Red Bluff Arch, a subsurface geologic structure (Pierce 1983). The Basin is located in Tehama and Shasta Counties and contains six subbasins: Bowman, Rosewood, Anderson, Enterprise, Millville and South Battle Creek. Since information about major sources of recharge, groundwater quality and discharge pathways and sources of contaminants applies to the entire basin, we have included narratives about these in this section. Other specific information about the individual subbasins is included in their individual sections.

Major Sources of Recharge

Recharge to the principal aquifer is mostly by subsurface inflow, infiltration of streamflows at the margins of the subbasin, and infiltration of precipitation and irrigation water. Groundwater movement is generally from the periphery of the basin towards the Sacramento River and then southward, where at the Red Bluff Arch, the water in the sedimentary rocks of Tertiary and Quaternary age is probably discharging into the Sacramento River (Pierce 1983). Therefore, subsurface flow enters the subbasin from the west, and discharges to the east. The major sources of streamflow infiltration are Cottonwood Creek and Dry Creek. Annual precipitation ranges from 23 to 27 inches/yr. The average specific yield for the Redding basin reported to be 8.5%. Storage capacity for the entire Redding basin, assuming and average aquifer thickness of 200 feet, is 5.5 maf (Pierce 1983).

Water Quality

Groundwater in the Redding Basin is characterized as magnesium-calcium bicarbonate and calcium-magnesium bicarbonate type waters. TDS ranges from 70 to 247 mg/L. Groundwater quality problems include localized high boron concentrations. There is a potential to induce the saline water in the Chico Formation to move upward if pumpage from the Tuscan and Tehama Formations is increased significantly (Pierce 1983). Table 4-86 summarizes the results from Pierce (1983).

Table 4-86. Concentrations of Constituents of Concern Detected in the Redding Basin in 1979

Constituent Type	Constituent of Concern	Concentration ranges	Standards
Nutrients	Nitrate as N	0–10 mg/L, median is 0.59 mg/L	10 mg/L
Salt—primarily as electrical conductivity and total dissolved solids.	Dissolved Solids	95–424 mg/L, median is 166 mg/L	500 mg/L (SMCL)
Trace elements	Arsenic	1–48 µg/L, median 1 µg/L	10 µg/L (MCL as of January 23, 2006)
	Barium	10–100 µg/L, median 30 µg/L	2,000 µg/L (MCL)
	Cadmium	1–2 µg/L, median 1 µg/L	5 µg/L (MCL)
	Chromium	0–10 µg/L, median 0 µg/L	100 µg/L (MCL)
	Chloride	0–140 mg/L, median 3 mg/L	250 mg/L (SMCL)
	Copper	0–14 µg/L, median 1 µg/L	1,000 µg/L (SMCL)
	Fluoride	0–0.3 mg/L, median 0.1 µg/L	4 mg/L (MCL)
	Iron Fe	10–40 µg/L, median 10 µg/L	300 µg/L (SMCL)
	Lead	0–2 µg/L, median 0 µg/L	15 µg/L (MCL)
	Manganese	1–50 µg/L, median 3 µg/L	50 µg/L (SMCL)
	Mercury	0–0.1 µg/L	2 µg/L (MCL)
	Selenium	0–1 µg/L, median 0 µg/L	50 µg/L (MCL)
	Silver	0	0.10 mg/L (SMCL)
	Sulfate	0–170 mg/L, median 3 µg/L	250 mg/L (SMCL)

Notes:
MCL = Maximum Contaminant Level set by EPA (2005).
µg/L = micrograms per liter.
mg/L = milligrams per liter.
SMCL = Secondary Maximum Contaminant Level set by EPA (2005).
Source: Pierce 1983.

Groundwater quality samples were also collected by the USGS in the area surrounding Cottonwood Creek during October 1982 and May 1983 (Fogelman and Evenson 1985). Cottonwood Creek borders Bowman subbasin on the north. Groundwater quality in the Cottonwood Creek area at that time was considered good to excellent with respect to recommended standards. Chemical quality varied little both spatially and seasonally. Groundwater levels were higher in the spring and lower in the autumn, coinciding with precipitation patterns.

One well had high nitrate (as nitrogen) concentrations (12 mg/L during October 1982 and 9.2 mg/L during May 1983). The EPA primary drinking-water limit for nitrate (as nitrogen) is 10 mg/L. This well was a shallow domestic well located at a farmhouse surrounded by pasture. The shallow well depth, shallow water level, and locale of this well lead to the conclusion that the nitrate problem is probably a result of surface contamination through the well borehole.

Water samples from a test well drilled by the Corps of Engineers exceeded the EPA primary drinking-water limit for arsenic at two of the three depth intervals sampled. Water samples from 246 feet had an arsenic concentration of 0.066 mg/L, and samples from 176 feet had an arsenic concentration of 0.06 mg/L. Arsenic can be acutely or chronically toxic to humans and plants. The EPA has established 0.01 mg/L as the primary drinking-water standard (as of 1/23/06).

Water from two wells exceeded the 0.05-mg/L secondary standard for manganese, with concentrations of 0.066 and 0.13 mg/L. Manganese is objectionable in public water supplies because it affects taste, stains plumbing fixtures, spots laundered clothes, and causes accumulation of oxide deposits in distribution systems.

One well was sampled at three intervals during October 25–26, 1982, for trace metals as well as the standard chemical analyses used in the semiannual ground-water samples. The sample depths were 246 feet, 176 feet, and 104 feet. These samples show that concentrations of calcium, magnesium, sulfate, manganese, cadmium, molybdenum, strontium, and vanadium decrease with increasing depth, and dissolved solids, sodium, alkalinity, chloride, arsenic, boron, lead, lithium, and zinc concentrations increase with increasing depth.

The DPR verified detections of five compounds in Shasta County between 1985 and 2003. There were 2 detections total: 1 detection of ACET and 1 detection of DACT. Verified detections are those that are found at more than one sampling date. These groundwater contaminants were the result of legal, agricultural uses. We did not have access for specific locations for these water quality results.

Discharge Pathways and Sources of Contaminants

Groundwater in the Redding basin generally follows the topographic gradients toward the Sacramento River and then in a general south-southeast direction. At the Red Bluff Arch, the Redding groundwater basin is probably losing to the Sacramento River (Pierce 1983).

Management Practices

There is little current information that points to effects of specific management practices on groundwater quality in the Redding Basin.

Bowman Subbasin— Redding Basin

General Basin Parameters

Acreage, Physiography

The Bowman subbasin is bounded on the west by the Coast Ranges; on the north by Salt, Dry, and Cottonwood Creeks; on the east by the Sacramento River; and on the south by the Red Bluff Arch. The Red Bluff Arch is defined as the hydrologic divide between the drainages of Cottonwood Creek and Hooker Creek to the north and the drainages of Blue Tent Creek, Dibble Creek, and Reeds Creek to the south. The subbasin is 78,500 acres (123 mi^2) in size and is located in Tehama County.

The following description of the hydrogeology in the Bowman subbasin is taken from DWR Bulletin 118 (DWR 2004). The subbasin aquifer system consists of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene alluvium and Pleistocene Modesto and Riverbank Formations. The Tertiary deposits include Pliocene Tehama and Tuscan formations.

The Holocene alluvium consists of unconsolidated gravel, sand, silt and clay from stream channel and floodplain deposits. These deposits are found along stream and river channels. The thickness ranges up to 30 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer. Although the alluvium is moderately permeable, it is not a significant contributor to groundwater usage.

The Pleistocene Modesto and Riverbank formations consist of poorly consolidated gravel with some sand and silt deposited during the Pleistocene time. They are usually found as terrace deposits near the surface along the Sacramento River and its tributaries. Modesto Formation deposits are observed along parts of Cottonwood Creek and Hooker Creek and along the Sacramento River. Riverbank Formation deposits are observed along all major creeks. The thickness ranges up to 50 feet. These deposits are moderately to highly permeable and yield limited domestic water supplies.

The Pliocene Tehama Formation consists of locally cemented silts, sand, gravel, and clay of fluviatile origin derived from the Klamath Mountains and Coast Ranges and is the principal water-bearing formation in the subbasin. The formation is exposed over approximately 80% of the subbasin surface area. The thickness varies from 4,000 feet to the north to approximately 3,800 feet to the south along Interstate Highway 5. The thickness of the deposit thins to the west from Cottonwood and reaches a thickness of 2,500 feet at the Sacramento River.

The permeability of the formation is moderate to high with yields of 100–1,000 gpm.

The Pliocene Tuscan Formation is found interfingered with the Tehama Formation south of Cottonwood Creek. The overlapping thickness may reach up to 2,500 feet towards the Red Bluff Arch. The Tuscan Formation is the principal water-bearing formation at the eastern extents of the subbasin. The formation consists of volcanic gravel and tuffbreccia, fine- to coarse-grained volcanic sandstone, conglomerate, tuff, tuffaceous silt and clay predominantly derived from andesitic and basaltic source rocks. The formation is described as four separate but lithologically similar units, Units A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units.

Unit A is the oldest water-bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone. Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Coarse cobble to boulder conglomerate predominates the deposit in the eastern and northern parts of mapped unit. Unit C consists of several massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. Unit D consists of fragmental deposits characterized by large monolithologic masses of andesite, pumice, and fragments of black obsidian in a mudstone matrix. The unit has limited areal extents and may not occur within the Redding Basin. Permeability is moderate to high with yields of 100–1,000 gpm except for beds of tuff-breccia, which are essentially impermeable.

Long-term groundwater level data indicate a slight decline in groundwater levels associated with the 1976–1977 and 1987–1994 droughts, followed by a recovery to pre-drought conditions of the early 1970s and 1980s. Some wells increased in levels beyond the pre-drought conditions of the 1970s during the wet season of the early 1980s. Generally, the seasonal fluctuation is approximately 5- feet for normal and dry years. Overall, there does not appear to be any increasing or decreasing trends in groundwater levels.

The average specific yield for the Redding basin, in which the Bowman subbasin in located, is thought to be 8.5%. Storage capacity for the entire Redding basin, assuming and average aquifer thickness of 200 feet, is 5.5 maf (Pierce 1983). DWR (2004) estimated annual groundwater extraction for the subbasin for agricultural use at 350 acre-feet. Municipal and industrial use is approximately 9 acre-feet. Inflow via deep percolation of applied water is estimated to be 1,500 acre-feet.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1999. Agricultural land use accounts for about 3% of the subbasin, urban land use accounts for about 3% of the subbasin, and native land accounts for about 94% of the subbasin. Table 4-87 provides details of the land uses within the subbasin.

Table 4-87. Land Use in the Bowman Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	660	0.80
Field Crops	20	0.03
Grain and Hay	80	0.10
Pasture	1,710	2.20
Truck, Nursery, and Berry Crops	10	0.01
Idle	160	0.20
Semiagricultural and Incidental	60	0.10
Subtotal	2,700	3.40
Urban		
Urban Landscape	30	0.04
Urban Residential	1,840	2.30
Commercial	50	0.10
Industrial	50	0.10
Vacant	270	0.30
Subtotal	2,240	2.90
Native		
Native Vegetation	71,800	91.40
Barren and Wasteland	660	0.80
Riparian	300	0.40
Water	850	1.10
Subtotal	73,610	93.70
Total	**78,550**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

The Bowman groundwater subbasin is within the Shasta Tehama Subwatershed. Public agencies operating within the subbasin: Tehama County Flood Control and Water Conservation District, Anderson-Cottonwood ID, and Rio Alto Water District.

Tehama County adopted a groundwater ordinance in 1994. Key issues addressed in the ordinance are: mining groundwater for export, off-parcel groundwater use, and well pumping restrictions. In 1992 AB3030 provided a systematic procedure for an existing local agency to develop a formal groundwater management plan. Tehama adopted a countywide groundwater management plan pursuant to AB3030 in 1996.

No urban areas are located within the subbasin. Tehama County ordinance 1617 prohibits extraction of groundwater for export outside the county. This subbasin falls with the area included in the Shasta-Tehama Coalition.

Management Practices

There are no major cities in the basin and there is very little agriculture. Most of the land is native vegetation. Tehama County has an AB3030 groundwater management plan in place. DWR monitors groundwater levels in 8 wells semiannually and the DHS monitors 13 wells for water quality constituents. We could not identify information about specific management practices that affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

Data from DPR, USGS, and DWR provide somewhat limited picture of groundwater quality in the Bowman subbasin in that there is not extensive areal coverage for groundwater quality. There is currently insufficient information to develop conclusions about effects of irrigated agriculture on groundwater quality.

Rosewood Subbasin—Redding Basin

General Basin Parameters

Acreage, Physiography

The Rosewood subbasin is bounded on the west and northwest by the Coast Ranges, on the north by North Fork Cottonwood Creek, and on the southeast by Salt Creek, Dry Creek, and Cottonwood Creek. The subbasin is 46,500 acres (73 mi^2) in size and is located in Tehama County.

The following description of the hydrogeology in the Rosewood subbasin is taken from DWR Bulletin 118 (DWR 2004). The Rosewood subbasin aquifer system west of the Sacramento River is comprised of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene alluvium and Pleistocene Modesto and Riverbank Formations. The Tertiary deposits include the Pliocene Tehama Formation.

The Holocene alluvium consists of unconsolidated gravel, sand, silt and clay from stream channel and floodplain deposits. These deposits are found along stream and river channels. The thickness ranges up to 30 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer. Although the alluvium is moderately permeable, it is not a significant contributor to groundwater usage.

The Pleistocene Modesto and Riverbank Formations consist of poorly consolidated gravel with some sand and silt deposited during the Pleistocene time. They are usually found as terrace deposits near the surface along the Sacramento River and its tributaries. Modesto Formation deposits are observed along parts of Cottonwood Creek. Riverbank Formation deposits are observed along all major creeks. The thickness ranges up to 50 feet. The deposits are moderately to highly permeable and yield limited domestic water supplies.

The Pliocene Tehama Formation consists of locally cemented silts, sand, gravel, and clay of fluviatile origin derived from the Klamath Mountains and Coast Ranges. The formation is the principal water-bearing formation in the subbasin and is exposed over approximately 80% of the subbasin surface area. Thickness of the deposits is unknown but may reach up to 500 feet, thinning to the west where the Great Valley Sequence daylights at the subbasin boundary. The permeability of the formation is moderate to high with yields of 100–1,000 gpm.

Long-term groundwater level data indicate a slight decline in groundwater levels associated with the 1976–1977 and 1987–1994 droughts, followed by a recovery to predrought conditions of the early 1970s and 1980s. Generally, groundwater levels have a seasonal fluctuation of approximately 5–10 feet for normal and dry years. Overall, there does not appear to be any increasing or decreasing trends in the groundwater levels.

Major Sources of Recharge

Recharge to the principal aquifer is mostly by subsurface inflow, infiltration of streamflows at the margins of the subbasin, infiltration of precipitation and irrigation water. Groundwater movement is generally from the periphery of the basin towards the Sacramento River and then southward, where at the Red Bluff Arch, the water in the sedimentary rocks of Tertiary and Quaternary age is probably discharging into the Sacramento River (Pierce 1983). Subsurface flow originates in the west and flows east to southeast. Cottonwood and Dry Creeks recharge Rosewood subbasin on the north and southeast. Annual precipitation ranges from 23 to 27 inches/yr.

DWR estimated groundwater extraction for agricultural use to be 350 acre-feet. Municipal and industrial use is estimated to be approximately 9 acre-feet. Deep percolation of applied water is estimated to be 1,500 acre-feet.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1999. Agricultural land use accounts for about 4% of the subbasin, urban land use accounts for less than 1% of the subbasin, and native land accounts for about 96% of the subbasin. Table 4-88 provides details of the land uses within the subbasin.

Table 4-88. Land Use in the Rosewood Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	80	0.20
Field Crops	10	0.02
Grain and Hay	350	0.80
Pasture	1,220	2.60
Truck, Nursery, and Berry Crops	30	0.10
Vineyards	10	0.02
Idle	130	0.30
Semiagricultural and Incidental	60	0.10
Subtotal	1,890	4.10
Urban		
Urban Residential	170	0.40
Commercial	10	0.02
Vacant	20	0.04
Subtotal	200	0.40
Native		
Native Vegetation	43,200	92.80
Barren and Wasteland	800	1.70
Riparian	260	0.60
Water	190	0.40
Subtotal	44,450	95.50
Total	**46,540**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

The Rosewood groundwater subbasin is within the Shasta Tehama Subwatershed. Public agencies operating within the subbasin: Anderson-Cottonwood ID, and Igo-Ono Community Service District. Tehama County adopted a groundwater ordinance in 1994. Key issues addressed in the ordinance are: mining groundwater for export, off-parcel groundwater use, and well pumping restrictions. In 1992 AB3030 provided a systematic procedure for an existing local agency to develop a formal groundwater management plan. Tehama adopted a countywide groundwater management plan pursuant to AB3030 in 1996.

No urban areas are located within the subbasin.

Tehama County ordinance 1617 prohibits extraction of groundwater for export outside the county.

This subbasin falls with the area included in the Shasta-Tehama Coalition.

Management Practices

The DWR monitors groundwater levels in 4 wells semiannually. We were unable to find specific information about management practices that affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

Data from DPR, USGS, and DWR provide somewhat limited picture of groundwater quality in the Rosewood subbasin in that there is not extensive areal coverage for groundwater quality.

Anderson Subbasin—Redding Basin

General Basin Parameters

Acreage, Physiography

The Anderson subbasin is bounded on the west and northwest by bedrock of the Klamath Mountains, on the east by the Sacramento River, and on the south by Cottonwood Creek. The subbasin is 96,950 acres (151 mi^2) in size and is located in Shasta County.

The following description of the hydrogeology in the Anderson subbasin is taken from DWR Bulletin 118 (DWR 2004). The Anderson subbasin aquifer system is comprised of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene alluvium and Pleistocene Modesto and Riverbank Formations. The Tertiary deposits include Pliocene Tehama and Tuscan Formations. The Tehama Formation interfingers with the Tuscan Formation in the region between Interstate Highway 5 and the Sacramento River north of the city of Red Bluff.

The Holocene alluvium consists of unconsolidated gravel, sand, silt and clay from stream channel and floodplain deposits. These deposits are found along stream and river channels. The thickness ranges up to 30 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer. Although the alluvium is moderately permeable, it is not a significant contributor to groundwater usage.

The Pleistocene Modesto and Riverbank formations consist of poorly consolidated gravel with some sand and silt deposited during the Pleistocene time. They are usually found as terrace deposits near the surface along the Sacramento River and its tributaries. Modesto Formation deposits are observed along parts of Cottonwood Creek, Dry Creek, and along the Sacramento River. Riverbank terrace deposits are observed along all major creeks. The thickness ranges up to 50 feet. These deposits are moderately to highly permeable and yield limited domestic water supplies.

The Pliocene Tehama Formation consists of locally cemented silts, sand, gravel, and clay of fluviatile origin derived from the Klamath Mountains and Coast Ranges and is the principal water-bearing formation west of the Sacramento River. The formation is exposed over approximately 60 to 70% of the subbasin surface area. Thickness of the formation ranges from 1,000 to 4,000 feet from the northern subbasin boundary at the Sacramento River to Cottonwood Creek in the vicinity of Interstate Highway 5. Much of the deposit west of Anderson has a uniform thickness of approximately 500 feet which thins to the western subbasin boundary where the Great Valley Sequence daylights. The permeability of the formation is moderate to high with yields of 100–1,000 gpm.

The Pliocene Tuscan Formation is thought to interfinger with the Tehama Formation between the Sacramento River to the east and Interstate 5. The formation consists of volcanic gravel and tuff-breccia, fine- to coarse-grained volcanic sandstone, conglomerate, tuff, tuffaceous silt and clay predominantly derived from andesitic and basaltic source rocks. The formation is described as four separate but lithologically similar units, Units A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units.

Unit A is the oldest water-bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone. Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Coarse cobble to boulder conglomerate predominates the deposit in the eastern and northern parts of mapped unit. Unit C consists of several massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. Unit D consists of fragmental deposits characterized by large monolithologic masses of andesite, pumice, and fragments of black obsidian in a mudstone matrix. The unit has limited areal extents and may not occur within the Redding Basin. Permeability is moderate to high with yields of 100–1,000 gpm except for beds of tuff-breccia that are essentially impermeable.

Long-term groundwater level data indicates a slight decline in levels associated with the 1976–1977 and 1987–1994 droughts, followed by a gradual recovery to pre-drought conditions of the early 1970s and 1980s. Generally, the seasonal fluctuation ranges from 1 to 10 feet for normal and dry years. Overall, there does not appear to be any increasing or decreasing trends in groundwater levels.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1995. Agricultural land use accounts for about 15% of the subbasin, urban land use accounts for about 20% of the subbasin, and native land accounts for about 65% of the subbasin. Table 4-89 provides details of the land uses within the subbasin.

Table 4-89. Land Use in the Anderson Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Citrus and Subtropical	970	1.00
Deciduous Fruits and Nuts	1,300	1.30
Field Crops	340	0.40
Grain and Hay	420	0.40
Pasture	9,080	9.40
Truck, Nursery, and Berry Crops	230	0.20
Idle	1,540	1.60
Semiagricultural and Incidental	270	0.30
Subtotal	14,150	14.60
Urban		
Urban—unclassified	4,920	5.10
Urban Landscape	80	0.10
Urban Residential	11,000	11.30
Commercial	430	0.40
Industrial	2,150	2.20
Vacant	730	0.80
Subtotal	19,130	19.90
Native		
Native Vegetation	58,900	60.70
Barren and Wasteland	1,000	1.00
Riparian	2,260	2.30
Water	1,350	1.40
Subtotal	63,150	65.50
Total	**96,970**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

The Anderson groundwater subbasin is within the Shasta Tehama Subwatershed. Public agencies operating within the subbasin: Redding Area Water Committee, Anderson-Cottonwood ID, Clear Creek ID, City of Anderson, Keswick

Community Service District, City of Redding, Rio Alto WD, Shasta Community Service District and Shasta County Water Agency, IGO-ONO C.S.D.

Shasta County adopted a groundwater management ordinance in 1998. This ordinance requires a permit for groundwater exportation from the county. The cities of Redding and Anderson are urban areas located within the subbasin. This subbasin falls with the area included in the Shasta-Tehama Coalition.

Management Practices

The DWR monitors groundwater levels in 11 wells semiannually and water quality constituents in 6 wells. The DHS monitors 69 wells for water quality constituents. We were unable to find specific data for effects of management practices on groundwater quality in this subbasin.

Assessment of Data Adequacy and Need for Added Data

Data from DPR, USGS, and DWR provide somewhat limited picture of groundwater quality in the Anderson subbasin in that there is not extensive areal coverage for groundwater quality.

Enterprise Subbasin—Redding Basin

General Basin Parameters

Acreage, Physiography

The Enterprise subbasin is bounded on the west and southwest by the Sacramento River, on the north by the Klamath Mountains, and on the east by Little Cow Creek and Cow Creek. The subbasin is 60,900 acres (95 mi^2) in size and is located in Shasta County.

The following description of the hydrogeology in the Enterprise subbasin is taken from DWR Bulletin 118 (DWR 2004). The Enterprise subbasin aquifer system is comprised of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene Stream Channel Deposits and terrace deposits of the Modesto and Riverbank Formations. The Tertiary deposits are the Pleistocene Tehama Formation and the Tuscan Formation.

The youngest alluvium consists of unconsolidated gravel, sand, silt and clay from stream channel and floodplain deposits. These Holocene stream channel deposits are observed along the entire extents of the western boundary along the Sacramento River. These deposits are also observed along Stillwater Creek extending from the Klamath Mountains to the Sacramento River in the center of the subbasin and along Cow Creek on the eastern side. The thickness ranges to 50 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer. Although the alluvium is moderately permeable, it is not a significant contributor to groundwater usage.

The Pleistocene Modesto and Riverbank Formations consist of poorly consolidated gravel with some sand and silt deposited during the Pleistocene. They are usually found as terrace deposits near the surface along the Sacramento River and tributaries. The thickness ranges to 50 feet. They are moderately to highly permeable and yield limited domestic water supply from perched water tables.

The Pliocene Tehama Formation consists of locally cemented silts, sand, gravel, and clay of fluviatile origin derived from the Klamath Mountains and Coast Ranges. Thickness of the formation along the southern boundary ranges from 300 feet at the southwestern extents of the subbasin to 1,000 feet at the confluence of Cow Creek and the Sacramento River. From north to south along Cow Creek, the deposit uniformly increases in thickness from where the Chico Formation daylights near Bella Vista to a depth of 500 feet in the vicinity of Palo Cedro and to a depth of 1,000 feet at the Sacramento River. The permeability is moderate to high, with yields of 100–1,000 gpm. The formation interfingers with the Tuscan Formation along the eastern boundary; however, the extents are unknown.

The Pliocene Tuscan Formation consists of volcanic gravel and tuff-breccia, fine- to coarse-grained volcanic sandstone, conglomerate and tuff, tuffaceous silt and clay predominantly derived from andesitic and basaltic source rocks. The formation is described as four separate but lithologically similar units, Units A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units.

Unit A is the oldest water-bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone. Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Coarse cobble to boulder conglomerate predominates the deposit in the eastern and northern parts of mapped unit. Unit C consists of several massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. Unit D consists of fragmental deposits characterized by large monolithologic masses of andesite, pumice, and fragments of black obsidian in a mudstone matrix. The unit has limited areal extents and may not occur within the Redding Basin. Permeability is moderate to high with yields of 100–1,000 gpm except for beds of tuff-breccia, which are essentially impermeable.

Long-term groundwater level data indicate a gradual decline of approximately 5–10 feet associated with the 1976–1977 and 1987–1994 droughts, followed by a gradual recovery to pre-drought conditions of the early 1970s and 1980s. Evaluation of groundwater level data shows a seasonal fluctuation of approximately 5–10 feet and, for the semi-confined wells, between 10 and 15 feet for normal and dry years. Overall, there does not appear to be any increasing or decreasing trends in groundwater levels.

Land Use

Land use surveys were conducted within the subbasin by DWR in 1995. Agricultural land use accounts for about 12% of the subbasin, urban land use accounts for about 34% of the subbasin, and native land accounts for about 54% of the subbasin. Table 4-90 provides details of the land uses within the subbasin.

Table 4-90. Land Use in the Enterprise Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Citrus and Subtropical	40	0.10
Deciduous Fruits and Nuts	310	0.50
Field Crops	570	0.90
Grain and Hay	790	1.30
Idle	1,510	2.50
Pasture	3,920	6.40
Semiagriculture and Incidental	180	0.30
Truck, Nursery, and Berry Crops	120	0.20
Subtotal	7,440	12.20
Urban		
Urban—unclassified	2,720	4.50
Commercial	820	1.30
Industrial	240	0.40
Urban Landscape	290	0.50
Urban Residential	15,400	25.30
Vacant	1,410	2.30
Subtotal	20,880	34.30
Native		
Barren and Wasteland	120	0.20
Riparian	760	1.20
Native Vegetation	30,370	49.80
Water	1,380	2.30
Subtotal	32,630	53.50
Total	**60,950**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

The Enterprise groundwater subbasin is within the Shasta Tehama Subwatershed. Public agencies operating within the subbasin: Redding Area Water Committee, Bella Vista WD, Shasta Co. Water Agency, Shasta Community Service District. Shasta County adopted a groundwater management ordinance in 1998. This ordinance requires a permit for groundwater exportation from the county. There are no urban areas located within the subbasin. This subbasin falls with the area included in the Shasta-Tehama Coalition.

Management Practices

The DWR monitors groundwater levels in 17 wells semiannually and water quality constituents in 3 wells. The DHS monitors 43 wells for water quality constituents. We were unable to find specific information about effects of management practices on groundwater quality.

Assessment of Data Adequacy and Need for Added Data

Data from DPR, USGS, and DWR provide somewhat limited picture of groundwater quality in the Enterprise subbasin in that there is not extensive areal coverage for groundwater quality.

Millville Subbasin—Redding Basin

General Basin Parameters

Acreage, Physiography

The Millville Subbasin is bounded on the west by Cow Creek, Little Cow Creek, and the Sacramento River; on the north by the Klamath Mountains; on the east by the Cascade Range; and on the south by Battle Creek. The subbasin is 65,300 acres (102 mi^2) in size and is located in Shasta County.

The following description of the hydrogeology in the Millville subbasin is taken from DWR Bulletin 118 (DWR 2004). The Millville subbasin aquifer system is comprised of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene alluvium and Pleistocene Modesto and Riverbank Formations. The Tertiary deposits include the Pliocene Tehama Formation along the Sacramento River and the Tuscan Formation. The Tuscan Formation is the primary water-bearing unit in the subbasin.

The Holocene alluvium consists of unconsolidated gravel, sand, silt and clay from stream channel and floodplain deposits. These alluvial deposits are found along stream and river channels. The thickness ranges up to 30 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer. Although the alluvium is moderately permeable, it is not a significant contributor to groundwater usage due to its geomorphic distribution.

The Pleistocene Modesto and Riverbank Formations consist of poorly consolidated gravel with some sand and silt deposited during the Pleistocene. The formations are usually found as terrace deposits near the surface along the Sacramento River and tributaries. The thickness ranges to 50 feet. They are moderately to highly permeable and can yield limited domestic water supplies.

The Pliocene Tehama Formation consists of locally cemented silts, sand, gravel, and clay of fluviatile origin derived from the Klamath Mountains and Coast Ranges. The permeability of the formation is moderate to high with yields of 100–1,000 gpm.

The Pliocene Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone and volcanic ash layers and is the principal water-bearing formation in the subbasin. The formation is described as four separate but lithologically similar units, Units A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units.

Unit A is the oldest water bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone. Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Coarse cobble to boulder conglomerate predominates the deposit in the eastern and northern parts of mapped unit. Unit C consists of several massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. Unit D consists of fragmental deposits characterized by large monolithologic masses of andesite, pumice, and fragments of black obsidian in a mudstone matrix. The unit has limited areal extents and may not occur within the Redding Basin. Unit C is the primary surfacial deposit within the subbasin. Surfacial deposits of Unit B are exposed over 15 to 20% of the subbasin to the north.

Deposits of the Tehama and Tuscan Formations interfinger along the western extents of the subbasin. Deposits of the Chico Formation outcrop in the northern most portion of the subbasin in the vicinity of Little Cow Creek and Cow Creek. Deposits of the Tehama and Tuscan formations begin at the northern extents of the subbasin and increase in thickness to approximately 1,000 feet at the confluence of Cow Creek and the Sacramento River. In the vicinity of Palo Cedro, the thickness of the sediments is approximately 500 feet. The thickness of the deposits decreases to the east and deposits of the Chico Formation between Cow Creek and Oak Run Creek in the northern half of the subbasin show that the Tuscan has been totally eroded in those areas.

Long-term groundwater level data indicate a slight decline of approximately 5 feet associated with the 1976–1977 and 1987–1994 droughts, followed by a gradual recovery in levels to pre-drought conditions of the early 1970s and 1980s. Generally, seasonal fluctuations range from 2 to 8 feet for normal and dry years. Overall, there does not appear to be any increasing or decreasing trend in groundwater levels.

The average specific yield for the Redding basin, in which the Millville subbasin in located, is thought to be 8.5%. Storage capacity for the entire Redding basin, assuming and average aquifer thickness of 200 feet, is 5.5 maf (Pierce 1983).

Land Use

Land use surveys were conducted within the subbasin by DWR in 1995. Agricultural land use accounts for about 4% of the subbasin, urban land use accounts for about 3% of the subbasin, and native land accounts for about 93% of the subbasin. Table 4-91 provides details of the land uses within the subbasin.

Table 4-91. Land Use in Millville Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	150	0.20
Field Crops	220	0.30
Grain and Hay	60	0.10
Pasture	2,170	3.30
Rice	30	0.05
Idle	140	0.20
Semiagricultural and Incidental	80	0.10
Subtotal	2,850	4.40
Urban		
Urban—unclassified	20	0.03
Urban Landscape	20	0.03
Urban Residential	1,700	2.60
Commercial	80	0.10
Industrial	80	0.10
Vacant	10	0.02
Subtotal	1,910	2.90
Native		
Native Vegetation	59,900	91.80
Riparian	80	0.10
Water	510	0.80
Subtotal	60,490	92.70
Total	**65,250**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

The Millville groundwater subbasin is within the Shasta Tehama Subwatershed. Public agencies operating within the subbasin: Redding Area Water Committee, Bella Vista WD, Shasta Co. Water Agency, Shasta Community Service District. Shasta County adopted a groundwater management ordinance in 1998. This ordinance requires a permit for groundwater exportation from the county. There are no urban areas located within the subbasin. This subbasin falls with the area included in the Shasta-Tehama Coalition.

Management Practices

DWR monitors groundwater levels in 6 wells semiannually and water quality constituents in 5 wells. The DHS monitors 9 wells for water quality constituents. We were unable to find specific information about the effects of management practices on groundwater quality.

Assessment of Data Adequacy and Need for Added Data

Data from DPR, USGS, and DWR provide somewhat limited picture of groundwater quality in the Millville subbasin in that there is not extensive areal coverage for groundwater quality.

South Battle Creek Subbasin—Redding Basin

General Basin Parameters

Acreage, Physiography

The South Battle Creek subbasin is bounded to the west by the Sacramento River, to the north by Battle Creek, to the east by the Cascade Range, and to the south by the drainage divide along the north rim of Paynes Creek. The subbasin is 33,860 acres (53 mi^2) in size and is located in Tehama County.

The following description of the hydrogeology in the South Battle Creek subbasin is taken from DWR Bulletin 118 (DWR 2004). The South Battle Creek aquifer system is comprised of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include younger alluvium and the Pleistocene Modesto Formation. The Tertiary deposits include the Tuscan Formation and possibly the Tehama Formation along the Sacramento River. The Tuscan Formation is the primary water-bearing unit in the subbasin. The Tehama Formation interfingers wit the Tuscan Formation in the region between Interstate

Highway 5 and the Sacramento River north of the city of Red Bluff. The Tehama Formation may extend beyond the Sacramento River within the subbasin boundary; however, the deposit is not included here as a water-bearing formation.

The Holocene alluvium consists of unconsolidated gravel, sand, silt and clay from stream channel and floodplain deposits. These deposits are found along the Sacramento River. The thickness ranges up to 30 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer. Although the alluvium is moderately permeable it is not a significant contributor to groundwater usage due to its geomorphic distribution.

The Pleistocene Modesto Formation consists of terrace deposits containing poorly consolidated gravel with some sand and silt. These deposits are found along Inks Creek, Battle Creek and the Sacramento River. The thickness varies up to 50 feet. The sediments are moderately to highly permeable and yield limited domestic water supplies.

The Pliocene Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone and volcanic ash layers and is the principal water-bearing formation in the subbasin. Generally, the formation is described as four separate but lithologically similar units, Units A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units.

Unit A is the oldest water bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone. Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Coarse cobble to boulder conglomerate predominates in the eastern and northern parts of mapped unit. This portion of the formation is approximately 430 feet thick.

Unit C is the primary surfacial deposit in the subbasin and consists of several massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. The thickness of Unit C exposed in the vicinity of Tuscan Springs and Tuscan Buttes ranges from 165 to 265 feet. Unit D consists of fragmental deposits characterized by large monolithologic masses of andesite, pumice, and fragments of black obsidian in a mudstone matrix. The deposit varies in thickness from 30 to 160 feet. The total thickness of the Tuscan Formation ranges from approximately 750 feet in the northeastern extents of the subbasin to 2,400 feet at the Sacramento River.

The average specific yield for the Redding basin, in which the South Battle Creek subbasin in located, is thought to be 8.5%. Storage capacity for the entire Redding basin, assuming and average aquifer thickness of 200 feet, is 5.5 maf (Pierce 1983).

Land Use

Land use surveys were conducted within the subbasin by DWR in 1999. Agricultural land use accounts for about 7% of the subbasin, urban land use accounts for less than 1% of the subbasin, and native land accounts for about 93% of the subbasin. Table 4-92 provides details of the land uses within the subbasin.

Table 4-92. Land Use within the South Battle Creek Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Citrus and Subtropical	10	0.03
Deciduous Fruits and Nuts	880	2.60
Grain and Hay	70	0.20
Pasture	1,120	3.30
Idle	100	0.30
Rice	20	0.06
Semiagricultural and Incidental	10	0.03
Subtotal	2,210	6.50
Urban		
Urban Residential	10	0.03
Industrial	40	0.10
Vacant	30	0.10
Subtotal	80	0.20
Native		
Native Vegetation	30,800	90.90
Barren and Wasteland	90	0.30
Riparian	420	1.20
Water	300	0.90
Subtotal	31,610	93.20
Total	**33,900**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

The South Battle Creek groundwater subbasin is within the Shasta Tehama Subwatershed. The public agencies operating within the subbasin is the Tehama County Flood Control and Water Conservation District.

Tehama County adopted a groundwater ordinance in 1994. Key issues addressed in the ordinance are: mining groundwater for export, off-parcel groundwater use, and well pumping restrictions. In 1992 AB3030 provided a systematic procedure for an existing local agency to develop a formal groundwater management plan.

Tehama adopted a countywide groundwater management plan pursuant to AB3030 in 1996.

No urban areas are located within the subbasin. Tehama County ordinance 1617 prohibits extraction of groundwater for export outside the county. This subbasin falls with the area included in the Shasta-Tehama Coalition.

Management Practices

There are no major cities in the basin and there is very little agriculture. Most of the land is native vegetation. Tehama County has an AB3030 groundwater management plan in place. We were unable to find specific information about effects of management practices on groundwater quality.

Assessment of Data Adequacy and Need for Added Data

Data from DPR, USGS, and DWR provide somewhat limited picture of groundwater quality in the South Battle Creek subbasin in that there is not extensive areal coverage for groundwater quality.

Rock Prairie Basin

General Basin Parameters

Acreage, Physiography

The area of Rock Prairie Basin is 9 mi^2 (5,740 acres) it is located in southeastern Modoc County. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004).

The Rock Prairie Basin is an alluvial filled valley. It is bounded to the northeast by northwest trending faults. The basin is bounded to the northeast, southeast, and west by Pliocene basalt and to the southwest by Miocene basalt. The valley drains to the northeast. Graven and Baley reservoirs are located along the eastern boundary.

No hydrogeologic information was available from DWR for water-bearing formations, groundwater level trends, storage, budget, or groundwater quality.

Major Sources of Recharge

The primarily source of recharge is annual precipitation which ranges from 19 to 21 inches.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. The entire basin is comprised of native vegetation and water. Table 4-93 provides details on the distribution of land use throughout the Rock Prairie Basin.

Table 4-93. Land Use in the Rock Prairie Basin

Land Use	Acreage of Land Use	Percent of Land Use
Native		
Native Vegetation	5,229	91.11
Water	510	8.89
Total	**5,739**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Modoc County adopted a groundwater management ordinance in 2000. A key element of the Modoc County ordinance is the requirement of an export permit for groundwater transferred out of the basin (DWR 2004). California Pines CSD is the sole public water agency in the basin. This basin falls with the area included in the Pit River Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Round Valley Basin

General Basin Parameters

Acreage, Physiography

The Round Valley groundwater basin is located in Modoc County. The area of the basin is 7,270 acres (11 mi^2). It is northeast of Big Valley and surrounded entirely by Mountains. The basin is bounded to the northwest by Tertiary basalt of Ryan and Barbar ridges, to the north and northeast by Tertiary pyroclastic rocks of Horsehead Mountain, and to the south and southwest by Tertiary pyroclastic rocks.

Ash Creek enters the valley from the southeast and continues to flow to the southwest entering Big Valley through a narrows in Barber Ridge. The following description of the hydrogeology in the Round Valley Basin is taken from DWR Bulletin 118 (DWR 2004).

The primary water-bearing formations in Round Valley are Holocene sedimentary deposits, Pliocene lava flows, and the Plio-Pleistocene Bieber Formation. The Holocene sedimentary deposits include basin deposits, intermediate alluvium, and alluvial fan deposits. Basin deposits, located predominately in low-lying areas in the southeast central part of the valley, consist of unconsolidated interbedded silt, clay and organic muck having low permeability. These deposits are not considered to be a significant water-bearing formation.

Intermediate alluvium, found along the perimeter and the northwest central part of the valley, consists of unconsolidated silt and sand with some clay and gravel. These deposits are generally moderately permeable with gravel zones being highly permeable. Alluvial fan deposits consist of unconsolidated poorly stratified silt, sand, and gravel with some clay lenses. Because the fans occur in only a few small areas, they are not considered a significant source of water. Locally they may yield moderate amounts of water to wells.

The Bieber Formation consists of lake deposited diatomite, clay, silt, sand, and gravel. These interbedded sediments are unconsolidated to semi-consolidated and are moderately permeable. The principal water-bearing zones consist of white pumiceous sand and black volcanic sand, which yield large amounts of water to wells where there is sufficient thickness and continuity.

Pliocene lavas consisting of jointed and fractured basalt occur to the north and south of Round Valley on the surrounding ridges. The lavas are moderately permeable and serve primarily as recharge areas in the uplands. They may contain unconfined and confined zones near the margins of the valley.

Storage capacity for the Round Valley Basin is estimated to be 120,000 acre-feet to a depth of 200 feet (DWR 1963). DWR (1963) also notes that the quantity of useable water in storage is unknown. DWR estimates groundwater extraction for agricultural and municipal/industrial uses to be 400 and 4 acre-feet, respectively. This estimate is based on surveys conducted by the DWR during 1997.

Major Sources of Recharge

Recharge to the basin is from precipitation, irrigation infiltration, and stream infiltration. The average annual precipitation ranges from 15 to 19 inches. Deep percolation of applied water is estimated by DWR (2004) to be 460 acre-feet. Ash Creek enters the valley from the southeast and continues to flow to the southwest entering Big Valley through a narrows in Barber Ridge. Dutch Flat Creek and Rush Creek also flow through the Round Valley.

Groundwater within the sediments of Round Valley is recharged primarily from the upland recharge areas of Pliocene basalt northwest of Round Valley (DWR 2004). The Turner Creek Formation of Ryan Ridge is a barrier between the Round Valley aquifer and the groundwater moving downslope through Barber Canyon.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. Round Valley Basin is 37% Agricultural and 36% undeveloped. Table 4-94 provides details of the land uses within the basin.

Table 4-94. Land Use in the Round Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Grain and Hay	430	5.91
Idle	160	2.20
Pasture	2,050	28.20
Semiagricultural and Incidental	50	0.69
Subtotal	2,690	37.00
Native		
Native Vegetation	4,510	62.04
Water	70	0.96
Subtotal	4,580	63.00
Total	**7,270**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Modoc County adopted a groundwater ordinance in 2000. Groundwater ordinances generally affect the volume of groundwater that can be pumped and/or exported from the basin. A key element of the Modoc County ordinance requires an export permit for groundwater transferred out of the basin (DWR 2004). The Adin Community Service District is the only public water agency involved with the basin. There are no major urban areas within the basin. This basin falls with the area included in the Pit River Coalition.

Water Quality

Sodium bicarbonate type waters are present in the basin. The concentration of TDS ranges from 141 to 633 mg/L, averaging 260 mg/L. There is no information about groundwater quality problems.

Discharge Pathways and Sources of Contaminants

There is no information about sources of contaminants or discharge pathways.

Management Practices

Pasture land comprises 28% of the land uses in Round Valley Basin. Brush encroachment in rangelands can be controlled by removal of brush through controlled burns and/or mechanical and chemical treatment. Controlled burning in rangeland has been practiced in for a number of years both to improve grazing lands and reduce fire hazards. Herbicide application has been used to control brush as well.

Assessment of Data Adequacy and Need for Added Data

There is no water quality data available for Round Valley Basin. From DWR Bulletin 118, there does not appear to be any groundwater wells that exceed of federal or State standards.

Scotts Valley Basin

General Basin Parameters

Acreage, Physiography

Scotts Valley Basin is bordered to the east by the shoreline of Clear Lake and bounded on the west and the north by the Jurassic-Cretaceous Franciscan complex of metamorphic and sedimentary rocks that constitute the basement rock in the basin. The basin shares a boundary with the Big Valley Basin to the south and may be hydrologically contiguous. The area of the aquifer system is 11 mi^2 and is located in Lake County.

The following description of the hydrogeology in the Scotts Valley Basin is taken from DWR Bulletin 118 (2004). The Scotts Valley Basin lies adjacent to the west side of Clear Lake and extends northwesterly along Scotts Creek north to Hidden Lake. The aquifer system in Scotts Valley Basin is composed primarily of Quaternary alluvial and terrace deposits, and Plio-Pleistocene to Pleistocene lake and floodplain deposits. Plio-Pleistocene Cache Formation sediments overlie bedrock.

The channel deposits of Scotts Creek and the uppermost valley deposits in the southern portion of basin are composed of Quaternary alluvium. The active channel of Scotts Creek is underlain by uncemented gravel and sand, with silt and clay lenses. Sands and gravels within the alluvium have moderate to high permeability while the silt and clay lenses have a relatively low permeability. In the southern part of the valley, gravels and clays are interbedded at shallower depths representing portions of former stream channels. Wells extract variable amounts of water from these zones. Wells installed in sand and gravel lenses yield an average of about 230 gpm. Surficial lake deposits of sandy and silty clay are located in the northern portion of the basin. Underlying these deposits is a fairly continuous gravel stratum in which water is under artesian pressure. Groundwater is confined in the northern portion of the valley and is essentially unconfined in the southern portion. The confined aquifer is 3 to 10 feet thick and underlies approximately 2.4 mi^2 of valley floor at depths ranging from 85 to

105 feet. The unconfined aquifer underlying the southern valley floor varies in thickness from 40 to 70 feet.

The northern part of Scotts Valley is underlain by lake deposits of sandy and silty clay ranging in thickness from 60 to 90 feet. Permeability in the fine-grained lake deposits is low with specific yields ranging from about 3 to 5%.

Terrace deposits lie directly on bedrock or on older lake and floodplain deposits. These deposits are a continuation of terrace deposits as seen in the Western Upland aquifer system of Big Valley Basin to the south. They consist of poorly consolidated clay, silt, and sand, with some gravel lenses. Thickness of the deposits ranges from 50 to 100 feet. These deposits generally have low permeability due to high clay content. Available well records indicate reddish brown clays with little potential for significant water yield.

Pre-terrace sediments that exist in Scotts Valley area are identified as the Cache Formation based on the stratigraphic position and the lithologic similarity to known beds of that formation. The Cache Formation is largely made up of lake deposits; however, some stream deposits and volcanic ash lenses are likely included. The Cache Formation is identified from water well driller reports as a blue clay layer containing some gravel lenses that is several hundred feet thick. Permeability of the Cache Formation is generally low due to its high clay content; however, yields of groundwater extracted from gravel or ash lenses within the Cache Formation may be appreciable.

Evaluation of the groundwater level data shows an average seasonal fluctuation ranging from 5 to 10 feet for normal and dry years for wells located in the vicinity of Scotts Creek and Clear Lake. For wells located closer to the Coast Ranges the average seasonal fluctuation is approximately 20 to 40 feet for normal and dry years.

Long-term comparison of spring-spring groundwater levels indicates a slight decline in groundwater levels of up to 10 feet associated with the 1976–1977 and 1987–1994 droughts, followed by a recovery in levels to pre-drought conditions of early 1970s and 1980s. Overall there does not appear to be any increasing or decreasing trend in the groundwater levels.

Data indicates that lowering of groundwater levels accompanied by subsidence has occurred in Scotts Valley. Gravel has been extracted to average depths of 4 to 6 feet and up to 10 to 15 feet within Scotts Creek channel. This extraction has apparently resulted in the lowering of the stream channel and adjacent unconfined groundwater levels by about 3–4 feet in the southern portion of the valley.

The average specific yield for the depth interval of 0–100 feet is estimated to be 8% based on review and analysis of well logs. The storage capacity for the basin is estimated to be 5,900 acre-feet based on the above depth interval and estimate of specific yield. The useable storage capacity is estimated to be 4,500 acre-feet. Based on 1995 DWR surveys of land use and sources of water, groundwater extraction for agricultural use is estimated to be 4,200 acre-feet. Groundwater extraction for municipal/industrial uses is estimated to be 520 acre-feet. Deep percolation of applied water is estimated to be 1,000 acre-feet (DWR 2004).

Major Sources of Recharge

Recharge to the confined aquifer takes place in the forebay or unconfined zone in the southern portion of the valley. Percolation from Scotts Creek is the principal source of recharge with minor amounts from precipitation and applied irrigation water. Annual precipitation in the basin ranges from 31 to 35 inches, increasing the northwest.

Land Use

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for about 27% of the basin, urban land use accounts for about 18% of the basin, and native land use accounts for about 55% of the basin. Table 4-95 provides details on the distribution of land use throughout the Scotts Valley Basin.

Table 4-95. Land Use in the Scotts Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Citrus and Subtropical	5	0.06
Deciduous Fruits and Nuts	1,231	16.80
Idle	337	4.59
Pasture	313	4.27
Semiagricultural and Incidental	34	0.46
Vineyards	41	0.56
Subtotal	1,960	26.75
Urban		
Commercial	272	3.72
Industrial	1	0.01
Urban Landscape	32	0.44
Urban Residential	933	12.73
Vacant	108	1.48
Subtotal	1,346	18.38
Native		
Riparian	12	0.17
Native Vegetation	3,936	53.72
Water	72	0.99
Subtotal	4,020	54.87
Total	**7,326**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Lake County adopted a groundwater management ordinance for Scotts Valley Basin in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). Public water agencies in the basin include County of Lake, City of Lakeport WSA, and Scotts Valley WCD.

This basin falls with the area included in the Lake Napa Coalition.

Water Quality

Groundwater levels in the Scotts Valley Basin are monitored semi-annually by DWR at 3 wells and by Lake County at 6 wells. Miscellaneous water quality parameters are monitored by DWR biennially at one well. The DHS and its cooperators monitor for Title 22 water quality parameters in 9 wells.

Calcium-magnesium bicarbonate is the predominant groundwater type in the Scotts Valley Basin. TDS ranges from 140 to 175-mg/L, averaging 158 mg/L. Iron, manganese, and boron concentrations exceed EPA maximum acceptable concentrations for continuous irrigation for selected wells (DWR 2004). During the sampling period from 1994 to 2000 under the DHS Title 22 program, there was 1 well out of 7 wells sampled with concentration of primary inorganics detected above the MCL. One well of 9 wells sampled showed nitrate concentrations above the MCL.

Discharge Pathways and Sources of Contaminants

There is no available information about sources of contamination and discharge pathways.

Management Practices

According to the Sacramento River Watershed Evaluation Report (Sac Coalition 2004), agricultural producers in Lake County integrate BMPs including engineered drainage systems, cover crops, soil erosion prevention programs and buffer zones. Chemical Application Methods are almost exclusively ground sprayer or chemigation. Virtually all producers use PCAs that monitor orchard and vineyard pest populations and make formal written recommendations to control damaging pests. All PCAs are registered with the State of California.

Assessment of Data Adequacy and Need for Added Data

There is insufficient information for development of an understanding of the effects of irrigated agriculture on groundwater quality.

Chilcoot Subbasin—Sierra Valley Basin

General Basin Parameters

Acreage, Physiography

The Chilcoot subbasin aquifer is bounded to the north and east by Mesozoic granitic rocks and, to the south, by Tertiary Sierran basalt and pyroclastic rocks and Paleozoic metamorphic rocks. The basin is hydrologically connected to the Sierra Valley Subbasin to the west in the near surface but may be discontinuous at depth due to a bedrock sill. The aquifer system is 12 mi^2 in size and is located on the eastern side of the Sierra Valley Groundwater Basin in Plumas County.

The following description of the hydrogeology in the Chilcoot subbasin is taken from DWR Bulletin 118 (2004). The Chilcoot Subbasin is an irregularly shaped, complexly faulted valley. The surface drainage is a tributary to Little Last Chance Creek, which drains to the Middle Fork Feather River. The primary water-bearing formations in the Chilcoot Subbasin are the Holocene sedimentary deposits and silt and sand deposits, fractured and faulted Paleozoic to Mesozoic metamorphic and granitic rocks, and Tertiary volcanic rocks.

Holocene sedimentary deposits include alluvial fans and intermediate alluvium. Alluvial fans consist of unconsolidated gravel, sand, and silt with minor clay lenses. These deposits are located at the perimeter of the valley to a thickness of 200 feet and are a major source of confined and unconfined groundwater. The fan deposits coalesce or interfinger with basin, lake, and alluvial deposits. Specific yield ranges from 8 to 17%. The fans also serve as important recharge areas.

Intermediate alluvium consists of unconsolidated silt and sand with lenses of clay and gravel. Specific yield is estimated to range from 5 to 25%. This unit is limited in extent and is found along the margins of the basin. The deposits are up to 50 feet in thickness and yield moderate amounts of groundwater to shallow wells.

Sand and silt deposits are located in the northeast portion of the subbasin. The deposits are generally unconsolidated and have high permeability and porosity. Potentially large quantities of water may be extracted.

Volcanic rocks make up a portion of the bedrock outcrop north of Chilcoot along Frenchman Lake road. These rocks are fractured and faulted and produce between 5 and 10 gpm where wells encounter interconnected openings in the rock.

These rocks form the bedrock base of the subbasin and most of the surrounding mountain uplands. The metamorphic rocks underlie the eastern portion and the granitic rocks the western portion of the subbasin. Major north-south high angle faults form the contacts between these rocks. Several test wells drilled in a proposed subdivision in the area show that where wells encounter sufficient interconnected fractures, wells developed in these rocks can produce up to 20 gpm, but typically only produce 3–5 gpm (DWR 2004).

The estimated groundwater storage in the basin is 7,500,000 acre-feet to a depth of 1,000 feet (DWR 1963). The quantity of water that is useable is unknown. DWR (1973) estimates storage capacity to be between 1,000,000 and 1,800,000 acre-feet for the top 200 feet of sediments based on an estimated specific yield ranging from 5 to 8%. These estimates include the Sierra Valley Subbasin.

Major Sources of Recharge

Annual precipitation ranges between 13 and 17 inches, increasing to the south. (DWR 2004.)

Most of the upland recharge areas are composed of permeable materials occurring along the upper portions of the alluvial fans that border the valley. Recharge to groundwater is primarily by way of infiltration of surface water from the streams that drain the mountains and flow across the fans. A minor amount of recharge may also be derived from some of the Sierran volcanic rocks located south of the valley. Most of these rocks appear to be of fairly low permeability and only small quantities of recharge can be derived from them. (DWR 2004.)

Land Use

Estimates of groundwater extraction for the Chilcoot Subbasin are based on a survey conducted by the DWR during 1997. The survey included land use and sources of water. Estimates of groundwater extraction for agricultural and municipal/industrial uses are 64 and 72 acre-feet respectively. Deep percolation from applied water is estimated to be 400 acre-feet. (DWR 2004.)

Land use surveys were conducted within the basin by DWR in 1997. Agricultural land use accounts for over 25% of the subbasin, urban land use accounts for about 3% of the subbasin, and native land use accounts for about 71% of the subbasin. Table 4-96 provides details on the distribution of land use throughout the Chilcoot subbasin.

Table 4-96. Land Use in the Chilcoot Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Pasture	1,899	25.20
Semiagricultural and Incidental	28	0.37
Subtotal	1,927	25.54
Urban		
Industrial	30	0.39
Urban Landscape	5	0.07
Urban Residential	205	2.71
Subtotal	239	3.17
Native		
Native Vegetation	5,379	71.28
Subtotal	5,379	71.28
Total	**7,546**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

The Loyalton WD is included in this subbasin. Groundwater management is under the Sierra Valley Groundwater Management District (authorized by Senate Bill 1391, enacted in 1980.)

This subbasin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

DWR monitors groundwater levels at 15 wells semi-annually, and samples for miscellaneous water quality parameters at 15 wells (including subbasin 5-12.01) biennially. DHS and its cooperators sample for miscellaneous water quality parameters in 8 wells (frequency of sampling not specified.) (DWR 2004.)

Groundwater in the subbasin is bicarbonate type water with mixed cationic character. TDS concentrations for the Sierra Valley Groundwater Basin range from 110 to 1,620 mg/L, averaging 321 mg/L (DWR 2004).

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Sierra Valley Subbasin—Sierra Valley Basin

General Basin Parameters

Acreage, Physiography

The Sierra Valley groundwater subbasin is bounded to the north by Miocene pyroclastic rocks of Reconnaissance Peak, to the west by Miocene andesite of Beckwourth Peak, to the south and east by Tertiary andesite, and to the east by Mesozoic granitic rocks. The aquifer system is 184 mi^2 in size and is located in eastern Plumas and Sierra Counties.

The following description of the hydrogeology in the Sierra Valley subbasin is taken from DWR Bulletin 118 (2004). Sierra Valley is an irregularly shaped, complexly faulted valley. The Middle Fork Feather River heads in Sierra Valley and is formed by the confluence of several streams draining the surrounding mountains. Most of the smaller tributaries flow north and northwest to join the Middle Fork Feather before it exits the valley at the northwest corner of the basin.

The primary water-bearing formations in Sierra Valley are Holocene sedimentary deposits, Pleistocene lake deposits, and Pleistocene lava flows. The aquifers of the valley are mainly alluvial fan and lake deposits. The alluvial fans grade laterally from the basin boundaries into coarse lake and stream deposits. The deposits of silt and clay act as aquitards or aquicludes in the formation. Aquiclude materials are predominantly fine-grained lake deposits. In the central part of the basin, alluvial, lake and basin deposits comprise the upper 30–200 feet of aquitard material that overlies a thick sequence of interstratified aquifers and aquicludes.

Holocene sedimentary deposits include alluvial fans and intermediate alluvium. Alluvial fans consist of unconsolidated gravel, sand, and silt with minor clay lenses. These deposits are located at the perimeter of the valley to a thickness of 200 feet. The fan deposits coalesce or interfinger with basin, lake, and alluvial deposits. Specific yield ranges from 8 to 17%. The fans are a major source of confined and unconfined groundwater and also serve as important recharge areas.

Intermediate alluvium consists of unconsolidated silt and sand with lenses of clay and gravel. Specific yield is estimated to range from 5 to 25%. This unit is limited in extent and is found along streams and centrally in the basin. The deposits are up to 50 feet in thickness and yield moderate amounts of groundwater to shallow wells.

Lake deposits underlie the majority of the valley and range in thickness to 2,000 feet. These provide most of the groundwater developed in the valley. The deposits consist of slightly consolidated, bedded sand, silt, and diatomaceous clay with the sand beds yielding large amounts of groundwater to wells. Specific yield ranges from 1 to 25%. Well production reportedly ranges up to 3,200 gpm.

Pleistocene volcanic rocks consist of jointed and fractured basalt flows ranging in thickness from 50 to 300 feet. These rocks are moderately to highly permeable and yield large amounts of groundwater to wells. They also serve as a recharge area and, where buried by lake deposits, form confined zones with significant artesian pressures.

Increases in groundwater development in the mid-late 1970s resulted in the cessation of flow in many artesian wells and large pumping depressions formed over the areas where heavy pumping occurred. Water levels in a flowing artesian well in the northeast portion of the basin declined to more than 50 feet below ground surface by the early 1990s, when reductions in groundwater pumpage occurred. Through the 1990s groundwater levels in the basin have recovered to mid 1970s levels.

The estimated groundwater storage in the basin is 7,500,000 acre-feet to a depth of 1,000 feet. The quantity of water that is useable is unknown. Based on an estimated specific yield ranging from 5 to 8%, storage capacity is estimated to be between 1,000,000 and 1,800,000 acre-feet for the top 200 feet of sediments. These estimates include the Chilcoot Subbasin (5-12.02).

Based on a 1997 DWR survey of land use and sources of water, estimates of groundwater extraction for agricultural and municipal/industrial uses are 3,400 and 110 acre-feet respectively. Deep percolation from applied water is estimated to be 2,100 acre-feet.

As of 1975, the average well yield was 300 gpm, with a max yield of 1,800 gpm. Groundwater pumpage, at the time of the 1975 report, was below safe yield. (DWR 118-75.)

Major Sources of Recharge

Most of the upland recharge areas are composed of permeable materials occurring along the upper portions of the alluvial fans that border the valley. Recharge to groundwater is primarily by way of infiltration of surface water from the streams that drain the mountains and flow across the fans. Annual precipitation ranges from 13 inches in the valley to 29 inches in the upland areas to the south and west.

Land Use

Groundwater development, as of 1975, was limited for irrigation, domestic, and stock use, with a potential for moderate to high additional development. (DWR 118-75.)

Land use surveys were conducted within the subbasin by DWR in 1997. Agricultural land use accounts for about 33% of the subbasin, urban land use accounts for about 1% of the subbasin, and native land accounts for about 66% of the subbasin. Table 4-97 provides details on the distribution of land use throughout the Sierra Valley subbasin.

Table 4-97. Land Use in the Sierra Valley Subbasin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Grain and Hay	2,014	1.71
Idle	1,313	1.12
Pasture	34,507	29.34
Semiagricultural and Incidental	469	0.40
Truck, Nursery, and Berry Crops	451	0.38
Subtotal	38,753	32.95
Urban		
Urban—unclassified	426	0.36
Commercial	37	0.03
Industrial	237	0.20
Urban Landscape	28	0.02
Urban Residential	420	0.36
Vacant	143	0.12
Subtotal	1,292	1.10
Native		
Riparian	7,765	6.60
Native Vegetation	69,631	59.20
Water	183	0.16
Subtotal	77,579	65.95
Total	**117,625**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Water agencies within the basin include Loyalton Water District (public agency), Sierra Valley PUD (public), and Sierra Brooks Subdivision (private). Groundwater management for this basin is under the Sierra Valley Groundwater Management District (authorized by Senate Bill 1391, enacted in 1980) (DWR

2004). This subbasin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

A wide range of mineral type waters exists throughout the basin. Sodium chloride and sodium bicarbonate type waters occur south of Highway 49 and north and west of Loyalton along fault lines. Two well waters are sodium sulfate in character. In other parts of the valley the water is bicarbonate with mixed cationic character. Calcium bicarbonate type water is found around the rim of the basin and originates from surface water runoff. TDS in the basin range in concentration from 110 to 1,620 mg/L, averaging 312 mg/L.

The poorest quality groundwater is found in the central west side of the valley where fault-associated thermal waters and hot springs yield water with high concentrations of boron, fluoride, iron, and sodium (DWR 2004 and DWR 118-75). Several wells in this area also have high arsenic and manganese concentrations.

Boron concentrations in thermal waters have been measured in excess of 8 mg/L. At the basin fringes, boron concentrations are usually less than 0.3 mg/L. There is also a sodium hazard associated with thermal waters and some potential for problems in the central portion of the basin. (DWR 119-03, 2004.)

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

DWR monitors groundwater levels from 34 wells on a semi-annual basis, and performs miscellaneous water quality monitoring on 15 wells (includes subbasin 5-12.02) biennially. DHS and cooperators perform miscellaneous water quality assessments on 9 wells in the subbasin (does not specify frequency of sampling) (DWR 2004). We were unable to find specific information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

There is insufficient information to develop conclusions about how agriculture affects groundwater quality.

Squaw Flat Basin

General Basin Parameters

Acreage, Physiography

The area of the Squaw Flat Groundwater Basin is 2 mi^2 (1,300 acres) and is located in Glenn County. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004).

The Squaw Flat Basin is located due east of the Stony Gorge Reservoir Groundwater Basin. The basin is bounded on all sides by upper Cretaceous marine deposits. The basin consists of Quaternary alluvial deposits and is drained to the east by Logan Creek.

Hydrologic information was not available from DWR for the following: water-bearing formations, groundwater level trends, storage, budget, and groundwater quality.

Major Sources of Recharge

The primary source of recharge is precipitation is approximately 18 inches per year.

Land Use

Land use surveys were conducted in Glenn County by DWR in 1998. All acreage in the Squaw Flat Basin is designated as native vegetation.

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Glenn County adopted a groundwater management ordinance for the Squaw Flat Basin in 2000. There are no public or private water agencies in the basin. This basin falls with the area included in the Colusa Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Stony Gorge Reservoir Basin

General Basin Parameters

Acreage, Physiography

The Stony Gorge Reservoir Groundwater Basin is 2 mi^2 (1,070 acres) in size and is located in Glenn County. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004).

The Stony Gorge Reservoir Basin is located due south of Stony Gorge Reservoir. It is bounded on the east and northwest by lower Cretaceous marine deposits and bounded on the west by rocks of the Knoxville Formation. The basin consists of Quaternary alluvial deposits.

Additional hydrogeologic information was not available from DWR for the water-bearing formations, groundwater level trends, or groundwater storage in the basin. Based on a 1993 DWR survey of land use and water sources, groundwater extraction for municipal/industrial use in the basin is estimated to be 8 acre-feet. Deep percolation of applied water is estimated to be 38 acre-feet.

Major Sources of Recharge

Precipitation is the primary source of recharge is approximately 18 inches per year.

Land Use

Land use surveys were conducted within the basin by DWR in 1998. Agricultural land use accounts for about 3% of the basin, urban land use accounts for about 3% of the basin, and native land use accounts for about 94% of the basin. Table 4-98 provides details on the distribution of land use throughout the Stony Gorge Reservoir Basin.

Table 4-98. Land Use in the Stony Gorge Reservoir Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Idle	43	4.00
Pasture	40	3.74
Semiagricultural and Incidental	9	0.88
Subtotal	92	8.63
Native		
Barren and Wasteland	91	8.55
Riparian	30	2.83
Native Vegetation	808	75.81
Water	45	4.19
Subtotal	974	91.37
Total	**1,066**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Glenn County adopted a groundwater management ordinance in 2000. There are no public or private water agencies in the basin. This basin falls with the area included in the Colusa Coalition.

Water Quality

There is no groundwater quality data for this basin.

Discharge Pathways and Sources of Contaminants

There is no information about discharge pathways or sources of contamination for this basin.

Management Practices

There is no information about management practices affecting groundwater quality in this basin.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data to develop conclusions about effects of irrigated agriculture on groundwater quality.

Stonyford Town Area Basin

General Basin Parameters

Acreage, Physiography

The Stonyford Town Area Groundwater Basin is 10 mi^2 (6,440 acres) in size and is located in Glenn and Colusa Counties. The following description of the hydrogeology in the basin is taken from DWR Bulletin 118 (2004).

The Stonyford Town Area Basin consists of Quaternary stream terrace deposits and may be bounded on several sides by faulting of the Stony Creek Fault System. The basin is bounded to the west by Mesozoic Franciscan volcanic and metavolcanic rocks, to the north by metasedimentary rocks of the Franciscan Formation and Mesozoic ultrabasic intrusive rocks and the Knoxville Formation.

Additional hydrologic information was not available from DWR for water-bearing formations, groundwater level trends, and groundwater storage in the basin. Based on a 1993 DWR survey of land use and water sources, groundwater extraction for municipal and industrial uses is estimated to be 35 acre-feet. Deep percolation of applied water is estimated to be 400 acre-feet.

Total depths of domestic wells completed in the basin range from 30 to 220 feet, with an average of 108 feet (based on 40 well completion reports). Total depth of the single irrigation well reported in the basin is 76 feet. No information on well yield was found.

Major Sources of Recharge

Precipitation is the primary source of recharge and ranges from 21 to 23 inches per year.

Land Use

Land use surveys were conducted in Glenn and Colusa Counties by DWR in 1998. Agricultural land use accounts for about 20% of the basin, urban land use accounts for about 2% of the basin, and undeveloped land accounts for more than 77% of the basin. Table 4-99 provides details on the distribution of land use throughout the basin.

Table 4-99. Land Use in the Stonyford Town Area Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Grain and Hay	43	0.67
Idle	486	7.54
Pasture	734	11.40
Semiagricultural and Incidental	34	0.52
Subtotal	1,297	20.13
Urban		
Commercial	4	0.07
Industrial	10	0.15
Urban Residential	135	2.09
Vacant	9	0.14
Subtotal	157	2.44
Native		
Barren and Wasteland	64	0.99
Riparian	5	0.07
Native Vegetation	4,879	75.74
Water	40	0.62
Subtotal	4,988	77.43
Total	**6,442**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Glenn County adopted a groundwater management ordinance in 2000. Colusa County adopted a groundwater management ordinance in 1998. There are no public or private water agencies in the basin. Both these ordinances limit groundwater exports from the basin.

This basin falls within the area included in the Colusa Coalition.

Water Quality

Between 1994 and 2000, groundwater in the Stonyford Town Area Basin was sampled for primary inorganics, radiologicals, nitrates, pesticides, VOCs and SVOCs, and secondary inorganics, as required under DHS Title 22 program. None of the constituents were detected at concentrations above the MCL in either of the 2 wells sampled (DWR 2004).

Discharge Pathways and Sources of Contaminants

There was no available data for sources of contaminants or discharge pathways.

Management Practices

There was no available information for the effects of management practices on groundwater quality.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data for development of convulsions about affects of irrigated agriculture in this basin. However, there do not appear to adverse effects on groundwater quality.

Toad Well Area Basin

General Basin Parameters

Acreage, Physiography

The Toad Well Area groundwater basin is located in Siskiyou County and is 3,360 acres (5 mi^2) in size. The Toad Well Area Groundwater Basin is a fault-bounded basin consisting of Quaternary alluvial deposits. Faults bound both the east and west sides of the basin. The basin is bounded to the west by Tertiary basalt of Buck Mountain and on all other sides by Pleistocene basalt.

Major Sources of Recharge

Recharge to the Basin is from precipitation and stream infiltration. The average annual precipitation ranges from 55 to 57 inches.

Land Uses

Land use surveys were conducted within the basin by DWR in 2000. The land use within the Toad Well Area Basin is entirely Native (Table 4-100).

Table 4-100. Land Use in the Toad Well Area Basin

Land Use	Acreage of Land Use	Percent of Land Use
Native		
Native Vegetation	3,360	100.00
Total	**3,360**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

Siskiyou County adopted a groundwater management ordinance in 1998. Groundwater ordinances generally affect the volume of groundwater that can be pumped and/or exported from the basin. There are no major urban areas within the basin. This basin falls with the area included in the Pit River Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

Upper Lake Basin

General Basin Parameters

Acreage, Physiography

The Upper Valley Basin is 11 mi^2 in size and is located in Lake County. The following description of the hydrogeology in the Upper Lake Basin is taken from DWR Bulletin 118 (2004).

The Upper Lake Basin is an irregularly shaped basin at the north end of Clear Lake that includes Middle Creek Valley, Clover Valley, and Bachelor Valley, all of which extend to a main central valley opening to the south to Clear Lake. Middle Creek Valley and Clover Valley are bounded by Middle Mountain to the west and Pitney and Hogback Ridges to the east.

Middle Mountain is a fault-bounded block underlain by sandstone and shale of the Great Valley Sequence. Pitney and Hogback Ridges consist mainly of graywacke sandstone and shale with minor interbedded basalt and chert of the Jurassic-Cretaceous Franciscan Formation. Similar rock types also underlie the mountain ridge south of Tule Lake located west of the basin.

The contact between the bedrock materials bounding the unconsolidated alluvium generally defines the basin boundary. Bedrock units in the area include the Franciscan Formation and the Great Valley Sequence.

The aquifer system in the Upper Lake Basin is composed primarily of Quaternary alluvial deposits and Pleistocene terrace, lake, and floodplain deposits. The alluvium, lake, and floodplain deposits fill the valleys and contain nearly all water yielded to wells. The older Cretaceous and Jurassic formations generally form the uplands surrounding the alluvial basin.

Groundwater within bedrock mainly occurs in near surface fractures along the lower hills. Generally, groundwater in bedrock has not been developed. Bedrock units and terrace deposits yield very little water to wells.

The Quaternary alluvial deposits include channel alluvium, fan deposits, and older alluvium consisting of gravel, sand, and fines. The active channels of Middle Creek, Alley Creek, and Clover Creek, and all other smaller creeks that drain the area around the Upper Lake Basin are underlain by uncemented gravel and sand, with silt and clay lenses. Fan and older alluvial deposits occur at the mouths of some ravines and small canyons that enter into the valley. These deposits consist of a mixture of gravel, sand, and fines and reach a thickness of 40–50 feet. The thickness of the deposits decreases downstream to just a few feet.

The Pleistocene terrace deposits border the west and northwest sides of Middle Creek Valley and exist as isolated remnants above the valley floor. The deposits consist of poorly consolidated clay, silt, and sand with some gravel lenses. The deposits generally have a low permeability due to their high clay content and are less important as a groundwater source.

Fine grained lacustrine sediments and coarser grained floodplain deposits underlie the valley floors of Middle, Clover, and Alley creeks. These deposits overlie bedrock and older unconsolidated sediments. These sediments generally range in thickness from about 60 to 110 feet and, in the Middle Creek Valley area, form a confining layer for an underlying artesian aquifer system. The fine-grained lake deposits also contain numerous sand and gravel lenses representing portions of former stream channels. Permeability of the fine-grained lake deposits is low with specific yields ranging from about 3 to 5%. Sand and gravel lenses yield an average of 230 gpm.

The Cache Creek formation is a pre-terrace alluvial deposit consisting of lacustrine clays, sands, and gravels that overly bedrock in some places along the borders of the valley. The permeability of the formation is generally low.

The average specific yield for the depth interval of 0–100 feet is estimated to be 8% based on review and analysis of well logs for the Upper Lake Basin. The storage capacity for the basin is 10,900 acre-feet. The useable storage capacity is estimated to be 5,000 acre-feet. According to a 1995 survey, estimates of groundwater extraction for agricultural and municipal/industrial uses are 4,100 and 190 acre-feet respectively.

Major Sources of Recharge

Recharge of the principal aquifer is from Middle Creek, Clover Creek, and Alley Creek (DWR 2004), and precipitation in the basin ranges from 35 to 43 inches per year, increasing to the north. Deep percolation from applied water is estimated to be 2,100 acre-feet.

Land Use

Land use surveys were conducted within the basin by DWR in 2001. Agricultural land use accounts for about 48% of the basin, urban land use accounts for about 10% of the basin, and native land use accounts for about 42% of the basin. Table 4-101 provides details on the distribution of land use throughout the Upper Lake Basin.

Table 4-101. Land Use in the Upper Lake Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agriculture		
Deciduous Fruits and Nuts	1,181	16.26
Grain and Hay	111	1.52
Idle	353	4.85
Pasture	727	10.01
Rice	580	7.98
Semiagricultural and Incidental	84	1.16
Truck, Nursery, and Berry Crops	29	0.39
Vineyards	414	5.70
Subtotal	3,479	47.88
Urban		
Urban—unclassified	11	0.15
Commercial	50	0.68
Industrial	7	0.10
Urban Landscape	46	0.64
Urban Residential	595	8.18
Vacant	24	0.33
Subtotal	732	10.08
Native		
Riparian	513	7.06
Native Vegetation	2,447	33.68
Water	95	1.31
Subtotal	3,055	42.04
Total	**7,266**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

A groundwater management ordinance for Upper Lake Basin was adopted by Lake County in 1999. A key element of the Lake County ordinance is the requirement of an export permit for groundwater extraction and substitute pumping (DWR 2004). County of Lake is the only public water agency in Upper Lake Basin. This basin falls with the area included in the Lake Napa Coalition.

Water Quality

Magnesium bicarbonate and calcium bicarbonate water are the predominant groundwater types in the basin. TDS ranges from 180 to 615 mg/L, averaging 500 mg/L.

Boron has been detected is some wells in the basin; however, high boron is not a prevalent condition. Water quality analyses show high iron, manganese, EC, calcium, ASAR, and TDS (DWR 2004).

Discharge Pathways and Sources of Contaminants

Groundwater discharges primarily to Middle Creek, Alley Creek, and Clover Creek and local wells. There is no information about agricultural sources of contaminants.

Management Practices

Groundwater levels are monitored semi-annually by DWR at1 well and by Lake County at 12 wells. DWR monitors for miscellaneous water quality parameters at 3 wells biennially. The DHS and its cooperators monitor for Title 22 water quality parameters at 6 wells.

According to the Sacramento River Watershed Evaluation Report (Sac Coalition 2004), agricultural producers in Lake County integrate Best Management Practices (BMPs) including engineered drainage systems, cover crops, soil erosion prevention programs and buffer zones. Chemical Application Methods are almost exclusively ground sprayer or chemigation. Virtually all producers use Pest Control Advisors (PCAs) that monitor orchard and vineyard pest populations and make formal written recommendations to control damaging pests. All PCAs are registered with the State of California.

Assessment of Data Adequacy and Need for Added Data

There is insufficient data to determine whether there are groundwater quality impacts related to irrigated agriculture.

Yellow Creek Valley Basin

General Basin Parameters

Acreage, Physiography

The area of the Yellow Creek Groundwater Basin is 2,310 acres and it is located in Plumas County, to the southwest of Lake Almanor. It consists of Quaternary alluvium. The valley is bounded to the east by Mesozoic and Paleozoic marine sediments, bounded to the north and west by Tertiary volcanic rocks, and to the south by Recent volcanic and Paleozoic marine sediments. The valley is drained to the south by Yellow Creek.

Major Sources of Recharge

Recharge to the basin is from infiltration of precipitation and stream infiltration. Annual precipitation ranges from 39 to 43 inches. The valley is drained to the south by Yellow Creek.

Land Use

Land use surveys were conducted within the basin by DWR in 1997. Agricultural land use accounts for about 61% of the basin and native land use accounts for about 39% of the basin. There is no urban land in the Yellow Creek Valley basin. Table 4-102 provides details of the land uses within the basin.

Table 4-102. Land Use in the Yellow Creek Valley Basin

Land Use	Acreage of Land Use	Percent of Land Use
Agricultural		
Pasture	1,410	61.04
Semiagricultural and Incidental	0	0.00
Subtotal	1,410	61.00
Native		
Native Vegetation	870	37.66
Riparian	30	1.30
Subtotal	900	39.00
Total	**2,310**	**100.00**

Coalitions, Water Districts, Major Urban Areas—Pertinent Ordinances or Regulations

No known groundwater management plans, groundwater ordinances, or basin adjudications. No know water agencies. No urban areas. This basin falls with the area included in the Upper Feather Upper Yuba Coalition.

Water Quality

We were unable to identify groundwater quality data in this basin.

Discharge Pathways and Sources of Contaminants

We were unable to identify groundwater discharge pathways or information about sources of contamination.

Management Practices

We were unable to find information about how management practices affect groundwater quality.

Assessment of Data Adequacy and Need for Added Data

We were unable to identify groundwater quality data in this basin.

San Joaquin Valley Groundwater Basin—Introduction

Organization and Elements

The San Joaquin Valley Groundwater Basin lies within the San Joaquin River and Tulare Lake Hydrologic Regions (HRs). The northern portion of the basin is within the San Joaquin River HR and consists of nine subbasins. These subbasins are the Cosumnes, Eastern San Joaquin, Tracy, Modesto, Turlock, Merced, Delta-Mendota, Chowchilla, and Madera (Figure 4-3). The southern portion of the basin lies in the Tulare Lake HR and consists of seven groundwater subbasins. These subbasins are the Kings, Westside, Kaweah, Tulare Lake, Pleasant Valley, Tule, and Kern (Figure 4-4). These subbasins are described in detail below.

The San Joaquin River HR portion of the basin covers approximately 3.73 million acres with the Tulare Lake HR portion of the basin covering approximately 5.15 million acres. Groundwater is extensively used in the San Joaquin Valley Groundwater Basin by agricultural and urban entities and accounts for approximately 48% of the groundwater used in the State (DWR 2003).

Information presented includes general descriptions on information sources, BMPs, overview of agricultural chemical impacts to groundwater, and data adequacy. Physiography, major sources of groundwater recharge, land uses, water quality, and contaminant sources and discharge pathways are presented by subbasin following the general discussions.